K-QL
698
W45

THE LIBRARY
OF
THE UNIVERSITY
OF CALIFORNIA

PRESENTED BY
PROF. CHARLES A. KOFOID AND
MRS. PRUDENCE W. KOFOID

THE MIGRATION OF BIRDS

A CONSIDERATION OF HERR GÄTKE'S VIEWS

BY

F. B. WHITLOCK

Author of "Birds of Derbyshire," &c., &c.

(ALL RIGHTS RESERVED)

London
R. H. PORTER
7, PRINCES STREET, CAVENDISH SQUARE, W.
—
1897

JOHN BALE & SONS
PRINTERS
LONDON
87 Great 85
Tottenham Court Road

Bcol.
Lib.

PREFACE.

MIGRATION has, to me, always proved the most fascinating feature of bird life. I therefore looked forward to the appearance of Herr Gätke's long-expected work with the greatest interest. On its first perusal, the novelty of the author's statements greatly impressed me, and after careful study I found them very difficult of acceptance. I then formed the plan of writing a paper to one of the current ornithological journals, calling attention to what I considered were the principal objections.

I soon found, however, that the subject was too great for this to be practicable. After some hesitation I decided to publish this little work on my own responsibility.

To prevent misconception, I must here state that the first draft of my manuscript was completed before I saw Mr. W. Eagle Clarke's "Digest of the Reports on Migration;" and though I was glad of the opportunity the latter gave me of strengthening my arguments, it must be understood that where our conclusions are identical, they have been arrived at quite independently of one another.

In writing my commentary I hope I have succeeded in guarding against any expression at all likely to convey the idea that I hold any feelings towards Herr Gätke but those of the warmest admiration and respect.

My sole aim has been to place the other side of the question before my readers, to the best of my ability.

F. B. W.

49, *Gregory Boulevard, Nottingham.*
January, 1897.

M361929

INTRODUCTION.

It has long been known that the little island of Heligoland, in the North Sea, is a spot especially favoured as a place of call, by passing birds during their long migrations to and from their breeding grounds. From time to time items of news, in the shape of short notes, relating to the island, or the account of a visit made by some enterprising ornithologist, have appeared in the current ornithological journals, from which some idea of the marvels of the place might be gathered. But at no time has any attempt been made by a resident on the island itself, to give a detailed account of the volume and character of the migratory phenomena to be witnessed there. It has, however, been no secret that one, with whose name that of Heligoland has long been associated—Herr Heinrich Gätke, has been for many years accumulating material for such a work.

The appearance of "Die Volgelwarte Helgoland," printed in the German language, some four years ago, was hailed with universal welcome, and in response to a unanimous demand an English translation was published early in 1895.

In a volume replete with interest, special prominence will be found attaching to the author's opinions expressed in the leading chapters relating to the direction, attitude, velocity, order, guiding power, and meteorological conditions affecting the migratory flight. The remainder of the work being chiefly occupied by notes on the various species visiting the island, under their separate headings.

No one has perhaps more closely studied, or had better opportunities for the observation of the different phases of

migration, than the veteran author; and the results of his fifty years or more of labour, as now presented to the notice of the ornithological world, are eloquent testimony to the untiring zeal and energy of an accomplished field naturalist.

The opinions he expresses, on the special department of ornithological science, for the study of which Heligoland is so pre-eminently adapted, will naturally have the greatest weight with all, and some in their admiration for the veteran observer have formed the opinion, that all, or nearly all of our previous conceptions, as to the direction, attitude and velocity of the migratory flight, will have to be greatly modified or altogether abandoned in favour of those he sets before us.

In the study of so complex a subject as the why and whither of the migration of birds in general, much diversity of opinion is naturally to be expected, and whilst the views of Herr Gätke are entitled to the respect his long experience demands, it will not be surprising perhaps, if others find, in the observations which he presents to our notice in support of the conclusions at which he has arrived, evidence which may just as readily be urged in favour of results quite as different.

In estimating the value of his various theories, it must not be forgotten that they are based on observations conducted in a very limited and somewhat exceptionally situated area; outside this area his personal experience seems to have been very small.

THE MIGRATION OF BIRDS

A CONSIDERATION OF HERR GÄTKE'S VIEWS.

ERRATA.

Page 2, line 10, *for* "attitude" *read* "altitude."
,, 19, ,, 16, *for* "Anglica" *read* "Anglia."
,, 28, ,, 7, *for* "west" *read* "east."
,, 32, ,, 21, *for* "Ochotok" *read* "Ochotsk."
,, 118, ,, 24, *delete* "may."
,, 131, ,, 18, *for* "parties" *read* "partner."

the general opinion held by the majority of naturalists.

This chapter also contains his remarks on the character or breadth of the migration front, in which the flight is performed. As the two subjects are intimately connected, his observations on both may be conveniently examined at the same time.

It has been previously more or less generally assumed, that the direction of the migratory flight in spring and autumn is approximately between the points of north and south. Whilst Herr Gätke fully recognises a movement of this description it seems to him, as may be gathered from his constant references, to be quite overshadowed in importance by an east to west flight—or the reverse

migration, than the veteran author ; and the results of his fifty years or more of labour, as now presented to the notice of the ornithological world, are eloquent testimony to the untiring zeal and energy of an accomplished field naturalist.

The opinions he expresses, on the special department of ornithological science, for the study of which Heligoland is so pre-eminently adapted, will naturally have the greatest weight with all, and some in their admiration for the veteran observer have formed the opinion, that all, or nearly all of our previous

THE MIGRATION OF BIRDS

A CONSIDERATION OF HERR GÄTKE'S VIEWS.

DIRECTION OF THE MIGRATION FLIGHT.

HAPTER I., though interesting, is to all intents and purposes a diary, and as a whole calls for no special comment. Such items as it contains, which are of exceptional value, can, therefore, readily be referred to as occasion may demand. In a detailed examination of the whole work it will be convenient to follow the author in his arrangement of the various chapters relating to the different phases of the migratory movement. His theories on the direction of the migration flight expressed in Chapter II., which next claims the attention of the reader; will be found of especial interest as they, to a great extent, controvert the general opinion held by the majority of naturalists.

This chapter also contains his remarks on the character or breadth of the migration front, in which the flight is performed. As the two subjects are intimately connected, his observations on both may be conveniently examined at the same time.

It has been previously more or less generally assumed, that the direction of the migratory flight in spring and autumn is approximately between the points of north and south. Whilst Herr Gätke fully recognises a movement of this description it seems to him, as may be gathered from his constant references, to be quite overshadowed in importance by an east to west flight—or the reverse

—according to the season of the year. Indeed, he frankly confesses that not a single bird is observed to adopt the former direction in arriving at, or departing from the island. It appears, therefore, that he is only driven to the admission that many species must of necessity migrate between the points of north and south by a consideration of their geographical distribution.

It will, perhaps, be convenient to first consider the evidence he presents in favour of this east to west flight. Before doing so, however, it will be necessary to examine his theory relating to the manner in which the travelling hosts of birds perform their annual migrations. On p. 24 he writes: "The predominant mode in which the migratory movement is performed is in a broad front or migration column, which in the case of species migrating to the west, corresponds to the latitudinal range of their breeding area, and in those migrating southwards, to the longitudinal extent of their nesting stations." It might be inferred from this, that the author wishes to convey the impression that there are many migratory streams of birds travelling east to west or north to south, but still leaving numerous wide gaps in the advancing rank. That this, however, is not his intention, is pretty evident from his remarks on the migrations of the Yellow-browed Warbler. On p. 30 he writes: "This bird appearing in Heligoland in favourable weather regularly every autumn, two, three or more individuals being frequently observed in one day, it surely ought also to occur in Germany with equal regularity and in fairly large numbers." And again, on p. 33, writing on the east and west migration in general, he remarks: "In this long wave of migration, however, each of the many hundreds of species which compose it, does not follow a migration route, more or less *narrowly limited* of its own, but all on setting out from their breeding area take up a westerly course which, within the latitude of their nesting relations, they pursue to its final goal. . . . . ." More to the point still are his remarks under the heading of "Exceptional Migration Phenomena." In discussing the question as to the justice of treating the Siberian species which have occurred in Heligoland as erratic wanderers, or otherwise, he writes (p. 118), "When we consider, as we are undeniably entitled to do, that the large number of individuals of

species from far eastern regions, which are met with in Heligoland, must stand to the quantity of these erratics passing through the whole of Central Europe every autumn, in the same relation as the size of this island does to that of the continent." Therefore, if in Heligoland alone from eighty to one hundred examples of the Yellow-browed Warbler, have been shot or seen during the last fifty years, it follows that the same species, but in proportionately greater numbers, must also have appeared in Germany or other parts of Europe during the same period.

The above extracts make it sufficiently clear that the author wishes his definition of a broad migration column to be taken in its most literal sense.

In comparing the area of Heligoland with that of Central Europe, one naturally only compares the area of the former, with a like area occupying the same longitude in the latter, as the flight is supposed to travel east to west. Otherwise the same individuals would be liable to be enumerated over and over again at various different points. But if we are to apply the before-mentioned theory to the rarer species, we are surely entitled to do the same in the case of the commoner ones.

To fully realise the significance of such a theory, we have only to take Herr Gätke's estimates of the numbers, comprising the flocks of Hooded Crows, Starlings, Skylarks and others, which pass the island, and multiply them by the vastly greater extent of Central Europe in comparison with Heligoland, to find that the results are something incredible and altogether impossible. It must not be forgotten, too, that migration for the most part, in the opinion of the author, takes place at altitudes beyond the powers of ordinary vision, and that such of it that comes within our cognisance is due to disturbances of the normal flight. It is only fair to mention, however, that the above-named species are amongst the few which usually perform their journeys at a very moderate elevation. There still remain the great majority, however, whose normal flight is performed at heights beyond our vision.

As an illustration of what in Herr Gätke's idea is the breadth of the migration front, his own words may be quoted. He writes as follows :—" In the case of the most different species, and in

districts so widely separated as Central Germany, Heligoland, the eastern coast of Great Britain—including the Orkney and Shetland Islands—Norway, up to a latitude of 70° N. in Finmark, the same results as to the direction of the migratory flight have been obtained. The latitudinal range of this migration front covers a stretch of no less than 960 geographical miles . . ." When it can be shown, as it undoubtedly can, that the breeding range of certain species—which according to his theories migrate east and west—entirely covers this distance, then, after also taking into consideration the estimated numbers of these species migrating past Heligoland alone, the full significance of his theory of a broad migratory column corresponding to the latitudinal area of the breeding range will be fully appreciated.

To return now to his views on the direction of the migratory flight. "Direct observations in Heligoland," he remarks, "either from watching the flight of passing migrants by day, or by noting their call-notes during the night hours, have established the following main results with regard to the direction of the migration flight, viz., that in autumn the migration proceeds from east to west and in the spring in the opposite direction. Further, that in the cases of all the species and individuals noted on the island, these courses are rigidly maintained during the passage, and such rare deviations as do occur never extend beyond one or two points of the compass. Not all birds, however, reach their winter destinations by an autumn passage proceeding in this simple westward direction. Many on the other hand are sooner or later obliged to turn southwards in order to reach the lower latitudes in which their winter quarters are situated; in the case of some species the original direction of flight is maintained throughout the whole immense stretch of road from the eastern countries bordering the Amoor river to the west of Spain." Herr Gätke here seems to have overlooked the fact that there is a difference in the latitude of the Amoor Valley and the west of Spain of ten degrees, or say seven hundred miles, but of course in so long a journey this does not proportionately amount to much. A flight, however, between these two points can hardly be said to be performed in a rigidly maintained east to west direction.

The words, "sooner or later," referring to a southward turn, in the above paragraph, are very indefinite. This is unfortunate, as it is plain, what a vast difference this turn must make in the numbers of birds which would pass Heligoland, if it takes place before the various flights reach the latter locality. To the writer, Herr Gätke seems to infer in other places that the majority do not travel southwards until they have crossed over the North Sea to the coasts of Great Britain; though there may be a few exceptions to this rule.

Now there can be no reason for doubting that a vast number of birds during their flight past Heligoland in the autumn, are actually seen travelling in the direction pointed out by Herr Gätke, and that their flight between these points can also be traced over a limited distance both east and west of the island. But a flight which has only been proved to trend in an east and west direction over such a comparatively small proportion o the whole journey, can hardly be held to be sufficient evidence that its original direction, from its commencement to its arrival at the latter locality, has been so rigidly or even approximately maintained as Herr Gätke endeavours to prove. As to the extreme view expressed above, that certain species perform a flight which is maintained in this direction from countries bordering on the Amoor to the west of Spain, there is to the writer, only the migrations of one species, viz., Richard's Pipit, that can be pointed to in support of such a theory, and the far eastern origin of the individuals which reach Heligoland, will be found, later on, to be open to doubt.

We are not expressly told what are the species which adopt this east to west line of flight, though they are said to amount to many hundreds. It is, however, possible to gather that amongst the most important are the following: — Buzzards, Starlings, Hooded Crows, Rooks, Jackdaws, Larks, Swifts, Plovers, Curlews and Geese. These species are mentioned on p. 25, and Godwits, Oystercatchers, Greenshanks, Sandpipers and Thrushes are enumerated in addition on p. 30. This list, however, leaves the remainder of the "many hundreds" mentioned on p. 33 to our imagination. It may be here pointed out that the majority of the smaller species, such as the Bluethroat

and other warblers, Wagtails, Flycatchers, Chats, &c., arrive and depart from the island in a manner which precludes the possibility of realising in what direction they are travelling at all.

On p. 37, however, we are also told that the direct north and south flight is *peculiar* to a large number of species (though it must not be forgotten that none are said to be *seen* to adopt this line of flight), more especially such as have their breeding quarters in high northern latitudes. In the face of this remark are we to eliminate from the above list the following, or not?—Shore Lark, Grey Plover, Dotterel, several species of Geese, Bar-tailed Godwit, Greenshank, Dusky Redshank, Green Sandpiper, Wood Sandpiper, Little Stint, Knot, Sanderling, and a few others. We know also that many of these species are seen during the migratory periods on both coasts of Scandinavia and also in the Baltic, and we should expect numerous flocks from the latter localities to touch on Heligoland. It must not be forgotten too that the breeding ranges of most of the species recorded as visiting the island, extend far to the north of the latitude of the latter. As instances, the Redwing, Fieldfare, and Hooded Crow may be mentioned. In considering from what regions the enormous flights passing Heligoland are derived, these facts are of the utmost importance. It is a pity, therefore, that the author is not more definite in his remarks as to the particular species following this east and west route, especially as some already mentioned are found during the winter season on the Mediterranean coasts. It would be interesting in the light of this theory to learn how these birds are supposed to reach the latter locality.

It may here be as well to quote Herr Gätke's definition of what he terms migration proper, or normal migration. On p. 46 he remarks—"Here I ought to remind the reader, that when I speak of migration proper, I mean those large extensive movements which, on the one hand in autumn, conduct our migrants from their breeding homes to or very near to their winter quarters in one uninterrupted, and for the most part nocturnal flight; and on the other hand, in spring, convey them in the opposite direction from their winter quarters to their breeding haunts—the uninterrupted continuity of the flight being

still more marked in this latter phase of the migratory phenomenon." From the above passage, read in conjunction with others on the altitude and velocity of the migratory flight, it will be clearly evident that the author's theories on the direction of the flight are based on observations made, when this migration proper has been interrupted and has therefore become in the light of his remarks, at any rate disturbed; but we may fairly assume that the direction is not affected in any case. Before going any further it may be as well to take a brief glance at the total number of species enumerated by Herr Gätke, as having occurred on the island. A convenient summary, by the late Henry Seebohm, appeared in the *Ibis*, vol. iv., 1892, pp. 1-32, and will be found sufficient for the purpose.

The total number known, or supposed to have visited Heligoland, is 396 (one or two more have been added since the publication of Herr Gätke's work). Of these some forty or more are admitted into the list, on evidence not quite conclusive. But if we remember that so many of the inhabitants of Heligoland are familiar with all the usual visitors, we shall not err, perhaps, in attaching more credence than usual in the case of these reputed occurrences, especially such as have the endorsement of Herr Gätke. At the same time one may be perhaps excused a feeling of envy towards Aeuckens, who possesses a memory which enables him, on the skin of a Warbler being submitted to his notice, to declare the species of the latter identical with the mutilated remains of another which passed through his hands some twenty-seven years previously. Seventy-five other species have been shot only once, though in a few instances other examples have been reported as seen near enough for identification. There still remain some 280 species which pass with greater or lesser regularity both in spring and autumn. A truly marvellous number if Herr Gätke's theories are borne in mind, and the small area under notice is not lost sight of. The total European *avi-fauna*, including Neartic and other stragglers, amounts to, in round numbers, 600 species, so that Heligoland can claim fully two-thirds.

In considering Herr Gätke's theory of a rigidly preserved east to west flight, it will be useful to learn what species have

reached the island which are not yet known to breed on the western side of the Urals, and to also learn in what numbers they have appeared.

As the result of upwards of fifty years' observation, we find the following have been recorded :—

Geocichla varia.—Thirteen examples caught, most of them in September and October. Seven or eight others seen.

Geocichla dauma.—An example in Lund Museum which may have been obtained on Heligoland.

Turdus Pallens.—A bird seen June 3rd, 1881, supposed to have been of this species.

Turdus fuscatus.—A young example caught in 1880.

Turdus ruficollis.—A young bird caught in November, 1843.

Turdus atrigularis.—An adult male once seen.

Phylloscopus fuscatus.—A bird supposed to have been of this species seen in October, 1876.

Phylloscopus superciliosus.—Seen about eighty times during fifty years. More than thirty examples shot.

Phylloscopus proregulus. — One killed October, 1845. A second seen October, 1895.

Phylloscopus coronatus.—One killed October, 1843.

Phylloscopus viridanus.—Three shot.

Phylloscopus nitidus.—One shot 1867.

Hypolais caligata.—One shot September, 1851.

Locustella certhiola.—One shot.

Cinclus Pallasi.—Supposed to have been seen twice.

Saxicola morio.—Two shot (this is, more correctly speaking, a south-eastern species).

Anthus Richardi.—A few in spring, pretty numerous in autumn.

Alauda sibirica.—Two shot.

Alauda tartarica.—One shot.

Emberiza pityornis.—One caught.

Emberiza luteola.—Two birds seen are supposed to have belonged to this species. (This is also more of a south-eastern species).

Parus kamschatkensis.—An example seen by Herr Gätke, but not obtained.

Charadius fulvus.—Three shot.

Charadius caspius.—Two shot, two supposed to have been seen.

A total numoer of twenty-four species. On the face of it this appears to be a remarkable record for so small an area. But out of the whole list only two can be looked upon as regular visitors, viz.:—

Phylloscopus superciliosus.—Average visits for fifty years, two per annum.

Anthus Richardi.—Fairly regular in spring, occurring in some numbers in the autumn.

Of the others *Geo. varia* occurs on an average once in two years. So far from the rest of Central Europe having produced the foregoing species in numbers proportionate to its vastly greater area, the exact converse is the case, and that these rare birds in such theoretical abundance have escaped notice, is highly improbable. This especially refers to the cases of Richard's Pipit and the Yellow-browed Warbler. Several other species are included in the European avi-fauna on the strength of single examples having been obtained on Heligoland alone. Of the remainder of the list, one or two, have been included on the evidence of supposed captures before Herr Gätke's time. About a third of the whole number have only occurred once. What the many other species from eastern Asia are which visit Heligoland in such large numbers every autumn (p. 33), one would be interested to learn.

If we take away the evidence of the far eastern origin of the vast flights of birds annually passing Heligoland in the autumn, afforded by the regular occurrence of *Anthus Richardi* and *Phyll. superciliosus*, but little remains to prove that any species in such distant countries, on setting out from their breeding area, take up a westerly course, which they maintain until they arrive at the coasts of western Europe and Spain. If the foregoing species mentioned, as only breeding east of the Urals, are not to be regarded as accidental stragglers, then, one cannot help being struck by the different manner in which Herr Gätke treats the occasional appearance of certain others, whose breeding grounds are much nearer Heligoland, but whose migratory flight, he admits, is performed from north to south. These individuals, on the contrary,

are pointed to as evidence of the undeviating character of the latter movement, their appearance on the island being described as of the rarest, though like the Siberian examples several have been obtained more than thrice.

So far, however, from treating the Siberian species as erratics, though their normal line of flight is also admitted to be north to south, they are supposed to be affected by some law or impulse to abandon the route pursued by the vast majority of their fellow-travellers, and to turn to the west by a voluntary act, which is not to be interpreted in the light of an accident, but in another place is explained as due to the prevalence of certain peculiar meteorological conditions at the time of their departure.

It must not be forgotten, too, that the flight of these Asiatic species, in common with the European, comes equally under the definition of the "broad migratory column" as before described. Many should, therefore, be found passing through or wintering in western and southern Europe in considerable numbers.

In Herr Gätke's opinion, the lack of evidence that such is the case is due to the fact that certain of them are so inconspicuous in size and appearance that the chances are all in favour of their escaping detection. This, he especially insists upon, is the case with the Yellow-browed Warbler, which, he thinks undoubtedly occurs in some numbers in Great Britain every year. In considering the chances of this contingency he overlooks one fact however. This species has most often been obtained in Heligoland in the month of October. Now in Great Britain, at this period of the year, all the other Phylloscopi will have already retired to their winter quarters. The appearance of a solitary example, therefore, would be sure to attract the attention of any observer interested in bird-life, and probably lead to the detection of the stranger. The call-note, too, has been described by Seebohm as quite distinct from that of its European congeners.

The case of *Anthus Richardi* is still more striking, though this species has been far more frequently detected in western Europe than the former. But, whereas, if by Gätke's rule the Yellow-browed Warbler should occur in hundreds, Richard's Pipit should be wintering somewhere in tens of thousands, or as he puts it himself, in incomputable numbers, and that such a

fine species, with its loud clear call-note, should be overlooked under such circumstances is simply incredible.

It will be seen at once that our acquiescence in the statement, that we are undeniably entitled to assume that these Asiatic species pass through central Europe in numbers proportionate to the larger area of the latter in comparison with the area of Heligoland, will depend in the first place on our acceptance of the theory that their western flight is performed in a broad column corresponding to the latitudinal extension of their breeding grounds; as their normal migrations are admittedly north to south, and in the absence of confirmatory evidence, the application of such a theory to these particular species seems to be quite unwarranted.

In perusing the contents of Herr Gätke's work, one is being continually struck with the high estimates he places on the numbers comprising the migratory flocks of birds passing the island.

Curiously enough it will be found, in the first place, that the species which migrate from east to west in autumn are said to amount to many hundreds (p. 33), and also that as many, if not more, preserve a line of flight from north to south. As the whole *avi-fauna* of Heligoland only amounts to some 400 species, one is rather puzzled how to account for these large figures.

It will be readily admitted that to arrive at an accurate result in calculating the numbers of rapidly moving objects is very difficult. It is equally difficult to arrive at a proper estimate of the value we are to place on the author's computations. In particular instances the reader can hardly fail to be struck by evidence of the grossest, though no doubt unintentional, exaggeration. This must perhaps be attributed to the artistic element in Herr Gätke's nature. As an instance of this exaggeration, the case of the Hooded Crow may be pointed out. On page 64 he writes of this species migrating "in millions, nay, billions"—an impossible estimate in any case, but still more incredible if we bear in mind his theory of a "broad migration column," and if we are also to assume that this statement refers to the neighbourhood of Heligoland alone. It is

doubtful if any species of bird exists in numbers approaching a billion. It is perhaps hardly necessary to point out that for *one billion* of Hooded Crows to cross a given longitude in the sixty days which Herr Gätke assigns as the duration of the migratory flight of this species, it would be necessary for no less than sixteen thousand six hundred millions to pass each day. It will also be observed that Herr Gätke is not even content with the singular number. Whatever the breadth of the migration column may be, such myriads are inconceivable.

In the article on "The Guillemot" also, we have another instance in which he allows his enthusiasm to run away with him. Referring to this species on p. 578 he writes of "countless myriads of birds swarming about in all directions in the air; equally innumerable long-extending companies are seen swimming near and far upon the sea"—an artistic description truly, but on further reference to the text we find that these "countless myriads" and "innumerable companies" resolve themselves into some fraction of a breeding colony of only 2,000 birds.

These remarks are not intended in any hypercritical spirit, but merely to serve as a warning to the reader not to attach too great an importance to statements that such and such species pass Heligoland in numbers which can only be derived from a breeding-range extending throughout the whole of Eastern Europe and Asia.

In presenting evidence of his theory of an east-to-west migration, Herr Gätke has wisely called attention to the flight of several species which are either conspicuous from their abundance, or from special interest attaching to their history. It will, therefore, be convenient to follow him in his remarks on each of these species in turn.

Before doing so, however, it may be as well to ascertain what portions of the continents of Europe and Asia we are fairly entitled to consider as belonging to the east. Of course, if we are to include all the vast territory lying to the east of the longitude of Heligoland, from the Mediterranean in the south to the Arctic Ocean in the north, and in like manner throughout Asia, then the theory of an east-to-west flight may be very easily accepted. But if, on the other hand, and bearing in mind the author's definition

of a rigidly maintained westerly flight, we take as our standpoint the latitude of Heligoland as constituting the only true east, then all points north of this latitude must be considered as only approximating to the east in lessening degree, until at last true north of the island is reached in Scandinavia. The same remarks, of course, apply to the south. It follows, therefore, that birds breeding in the north of Europe, and which may happen to pass Heligoland on autumnal migration, must travel in a direction more or less partaking of a direct southerly character, even should they at the actual time of passage be observed to be travelling due west. According to Herr Gätke, however, the southward turn is only adopted towards the end of a long westerly flight.

If we adopt, however, the definition of the east in its narrowest sense—as we might not unreasonably do in the light of the author's remarks on the rigidly-conducted line of flight—it follows necessarily that any species migrating from the east, and adhering to this course until it reached the longitude of Heligoland, will only be observed at the latter locality if the latitude of its nesting station corresponds with that of the island.—"All on setting out from their nesting stations take up a direct westerly course, which they pursue to its final goal," he writes (p. 33). This is an important point in considering the undeviating character of the flight, as described by Herr Gätke, and in face of the enormous numbers of birds annually recorded as passing his observation. For are we not told—to use his own words—that at Heligoland migration takes place in "extraordinary and unexampled grandeur" (p. 4). If we accept the theory of a broad migratory column, advancing due west from regions in the far east, we should naturally expect to find, in like manner, birds passing other points to north and south of the island in equal abundance.

These remarks especially refer to a well known species, viz., the Hooded Crow. The migration front of this species has on one occasion, according to the author, been known to cover a longitude of thirty-six miles in the immediate neighbourhood of the island, and possibly further still. But this distance is insignificant in comparison with the latitudinal extent of the breeding range. Roughly speaking, the latter includes Scandinavia and the

greater part of Europe east of the longitude of Heligoland, extending as far north as the limits of forest growth, and about as far south as lat. 48°; colonies also exist to the west and in north-eastern Africa; but it is not necessary to take the latter into account at the present juncture. Writing on the Hooded Crow, Seebohm remarks:—"Though the area of its distribution is intersected by the narrow belt of Carrion Crows, which connects the East Siberian colony with the Turkestan colony, and the latter with the west European colony, it cannot be said to be discontinuous. On the continent the Hooded Crow is found throughout Europe east of long. 10°, and in Asia extends north of Turkestan as far as the valley of the Yenesay. . . . The Scandinavian birds migrate to Holland, Belgium, and Northern France, and even to England, in winter; and many of the Siberian birds, together with hybrids of every degree, winter in Turkestan." Amongst the millions of this species which pass Heligoland every year, many of which, in Herr Gätke's view, are derived from regions in the far east, he has not detected any of these hybrids alluded to by Seebohm. Now what a remarkable fact it would be if the individuals breeding beyond the region where the former are produced, when migrating to the west, were not frequently accompanied by many examples of the latter. In the absence of these hybrids, it appears very unlikely that any of the great flights passing from Heligoland are really derived from a breeding area in far Eastern Asia. It will be observed that Herr Gätke assigns the Lena as the limit of this breeding area. On the other hand, most authorities mention the valley of the Yenesay.

Even if these hybrids were unnoticed by reason of their not passing directly over the island, they would hardly escape detection on their landing on the eastern coast of England, which Herr Gätke informs us is the next destination of the vast flights which pass his observatory.

What numbers of so voracious a species as the Hooded Crow any given area could support is very difficult to say. But if we consider the great quantities of Rooks which find a thriving living in a limited district like the Midland counties of England —where every village has its rookery—we may perhaps not deem

it necessary to have recourse to a country extending beyond the Urals to sustain even the millions of Herr Gätke, as he himself suggests.

How are we to account for the accumulation of these vast flocks, if we accept the theory that all on setting out from their nesting stations travel in a rigidly maintained westerly direction and in a broad column corresponding to the latitudinal area of the latter? Except at the periods of migration the Hooded Crow is not a particularly gregarious species, and though considerable numbers may be present in a small district, yet at their winter quarters small parties, rather than flocks, are met with as a rule. With regard to the breadth of these flights, the most that has been proved is, that on a certain occasion, viz., October 24th, 1884, the present species, in company with Rooks and Jackdaws, was observed to be passing over and near Heligoland in vast numbers, and in a flight having an ascertained frontage thirty-six or forty miles in extent, though we are not told this was an unbroken front. Now no country, due east of Heligoland, of this breadth, even if it extended as far as the Yenesay, would have been large enough to have produced the millions comprising this flight. Herr Gätke also further attempts to prove that this migration front covered a vastly greater breadth. At the same time, he writes, that an extraordinary migration was taking place "over the North Sea, on the eastern coast of England and Scotland up to the Orkney and Shetland Islands." On referring to the "Report on the Migration of Birds for 1884," it will be found that whilst there certainly was a large movement in progress on the east coast of England, within or around a latitude corresponding to that of Heligoland; further north, however, the numbers arriving were insignificant and not more than the normal. In support of this statement those portions of the same report relating to the east coast of Scotland may be quoted. On p. 28 we read—"In autumn, a more decided movement of Hooded Crows (this in comparison with spring, when less than usual were observed). Records from Sumburgh Head, North Ronaldshay, Pentland Skerries, Girdleness and Isle of May (none noted at Bell Rock). . . . . Decided rush between October 11th and 26th at Pentland Skerries (14th), and at Isle of May."

It will be observed that these dates do not altogether coincide with those recorded at Heligoland.

Now let us also see what constitutes a rush on the east coast of Scotland. Again quoting from the same source we find—"The numbers recorded are, on 11th and 12th one shot by J. A. H. B.; no more till 23rd; eighteen flying north (and Rooks), forty on 24th, and forty on 25th, with one Carrion Crow. Continued on 26th. Again in November, a number for some days at Sumburgh Head on 10th; also at Pentland Skerries a few, and the indication of a rush at Isle of May, on 12th and 15th, flocks of nine and twelve having been seen on these dates." Compared with the myriads recorded from Heligoland these numbers are utterly insignificant. [Though too long to be quoted here, the remarks of Messrs. Harvie Brown, and Cordeaux, on the stretches of coast on the east of Great Britain—most favoured as points of arrival by immigrant birds—will be found especially interesting in connection with the theory that migration is performed in a broad front (see reports for 1885).]

It may here be remarked with reference to this rush of Hooded Crows in October, 1884, that the chief lines of flight were S.E. to N.W., E. to W., and S. to N.W., as observed at various light vessels and lighthouses adjacent to the east coast of England; thus showing—if we grant the identity of the flocks passing Heligoland with those arriving on our Lincolnshire coast—that the rigid east-to-west direction, which this flight is originally supposed to have possessed, had undergone a certain amount of deviation before reaching the latter locality.

The above evidence will perhaps justify our assumption that over whatever breadth the migration front extended at the time of its inception, it had become considerably contracted by the time it reached our shores, and bore no adequate relation to the latitudinal area of the breeding range. And with regard to the general direction of the flight we cannot conceive that a district thirty-six miles, or fifty miles in breadth, even if it extend to the valley of the Lena, could produce the species in such great abundance. Does it not follow, therefore, that at some period of the journey, there must be concentration on to some common fly-line of all the migratory individuals of this species, from

districts intermediate, between the north-east and east of the latitude of Heligoland. If so, shall we be justified in calling a flight, which under these circumstances would trend more or less from N.E. to S.W.; a rigidly preserved westerly flight?

In suggesting a "concentration on to some common fly-line," it must not be inferred that this implies any special intention on the part of the flocks to meet together with this purpose in view, but to point more to a fortuitous circumstance, brought about possibly by the configuration of the country—as the Hooded Crow is a low flyer.

It is easy to see how this concentration may occur. If we glance at the map of Europe we shall find that the land reaches its highest northern latitude in Russia, at the extreme north-eastern boundary of the continent, and that as we travel westwards from thence, the coast line, as far as the shores of the White Sea, gradually falls away towards the south-west. If we grant for the moment that the Hooded Crows breeding in the regions above the arctic circle migrate due west from their nesting stations and rigidly preserve this direction of flight, they will sooner or later reach the shores of the Arctic Ocean. Now we have no reasons for thinking that at any point in the far north, they leave the land to migrate across the sea to the Kola peninsula. If, however, this actually takes place, then a continuance of their journey would take them to the west coast of Norway, where they must either turn south or cross the North Sea, and their further flight, in this case, would tend either to miss Heligoland altogether, or, at the most, to cross the island in a north to south direction. It seems, however, far more reasonable to suppose, that such migratory flocks which breed in the far north—still assuming that they take up a direct westerly course—would, on reaching the sea, follow the coast line to the delta of the Dwina, where other flights, from lower latitudes, would coalesce with them, and thus continue their further journeys in company. A similar concentration may very well take place at many points along the eastern shores of the Baltic; whether individuals in the first instance migrate due west or south-west; and we can thus see how the immense hosts observed at Heligoland may be marshalled together. The flocks comprising a

migration conducted in a broad front, and travelling west, would, on turning south at an identical longitude, naturally be converted into a comparatively narrow flight, and bearing no relation whatever to the latitudinal area of the breeding ground. It seems more probable that these migratory Crows would follow the eastern shores of the Baltic in preference to making an attempt to cross to the opposite coast in continuation of their westerly flight: for, as has been pointed out before, if they still persisted in a flight in the latter direction as far as shores of the Atlantic, they would hardly be likely to touch at Heligoland at all. Birds are very conservative in their habits, and there can be little doubt that inheritance comes largely into play when the locality of their winter home has to be determined. If we grant that the nature of migration at its first inception is to-day best represented by the intermittent movements of those species which may be said to hang about the fringe of the severest cold, we can understand that the habit of crossing wide seas, as is the practice of birds at the present time, must have been a later development; not from any lack of powers of flight, but more from a reluctance to attempt a journey leading to some unseen and unknown goal: indeed, the pioneers in a movement of this nature must, as far as we can see, have first undertaken such a flight through an accident or by force of circumstances, rather than design. We cannot imagine birds to have been gifted with a sense which enabled them to detect the presence of land in the far distance, and beyond their range of vision at this early stage of the development of the migratory habit. Thus the flights of Hooded Crows are more likely at this early period to have followed the coast line of such seas as they encountered, and have continued to do so to the present day. According to Herr Gätke's view, however, it is not the sight of the sea which turns birds to the south, though he does not tell us his reasons for coming to this conclusion. In bringing forward evidence in favour of the far eastern origin of these great flights of Hooded Crows, Herr Gätke is apt to lay too great stress on the fact that their direct westerly flight can be traced over a distance of six hundred miles, *i.e.*, from the shores of Schleswig Holstein to the interior of England; but it can readily be proved that only a small proportion, if any,

of the vast hosts he alludes to, ever reach the latter country; and even such as may do so, turn to the south soon after their arrival on the east coast. But in any case a westerly flight of some 600 miles is only a moderate fraction of the distance between central England and the valley of the Yenesay.

With regard to the ultimate distinction of these hordes, it seems to the writer, after considering all the evidence bearing on the subject, that soon after passing Heligoland the great majority turn towards the south or south-west, some passing inland into Germany, and the remainder wintering in Holland, Belgium and France, or, perhaps, still further south—as examples have been met with in Spain.

That any large proportion of these millions reach the east coast of Great Britain—which is the case, according to Herr Gätke—there is no evidence to prove. What would be the effect in East Anglica of an incursion of a voracious species like the present, in numbers approaching those observed at Heligoland? They could hardly fail to create a sensation, even if they were distributed over the whole littoral between the Humber and Thames. Certainly the species is observed in the late autumn in considerable numbers in our eastern counties; but there are no records referring its appearance in even tens of thousands. It is simply impossible that such huge numbers could escape observation. Neither do Hooded Crows on reaching the coast line pass very far inland to the extent Herr Gätke imagines. The following remarks of his, quoted from p. 26, are based on mere assumption. He writes:—"Now the Eastern and Midland counties of England cannot by any possible means afford sufficient room for furnishing winter quarters to the millions of Hooded Crows, which every autumn pass this island across the North Sea; and since, according to Rodd and Thompson, they do not reach either the West of England or Ireland, . . . it follows that they must very soon after reaching England pass across the channel to France." On p. 25 he further writes:—"The Hooded Crow does not get to the Western parts of England, but turns to the South as soon as it reaches the central portions of that country." These statements are rather contradictory, too, after having previously quoted Mr. Cordeaux's

remarks, to the effect that the species still flies directly inland to the west on arriving at the Humber. For if they pass inland in Lincolnshire, it follows that they must cross a wide district of England before they can reach the Channel to cross into France.

There is also no evidence to show, nor any reason to suppose, that they suddenly alter the character of their flight and pass over the central parts of England at a great elevation, and thus escape notice. For in the light of the author's theories on the altitude of flight, this would mean a sudden change of meteorological conditions immediately on their arrival; and the Hooded Crow is one of the few species which always fly low. That the present species is seen in moderate numbers, crossing England from north-east to south-west every autumn by certain well-known routes, will be readily admitted; but the evidence in favour of an immediate turn to the South on their first making the land, all points to its being the course adopted by the majority; for very large numbers (though not millions) have been observed following the line of the sand hills due south, on the Norfolk coast, in company with Rooks and Daws (see Migration Committee's Report). The Hooded Crow at its winter quarters seems to be a very aquatic species, and is very fond of wading in shallow waters in search of food. It appears natural for a species possessing these tastes to hug the coast line as much as possible during its migratory journeys, and in passing inland to follow the course of rivers—not as guides to its destination, but as convenient routes where food can be readily procured when required. That all the Hooded Crows observed in the eastern and midland counties reach us *viâ* Heligoland is, however, very improbable; for, according to Seebohm, many individuals breeding in Scandinavia winter in this country, and we should hardly expect Norwegian examples to travel past the island on their journey here. Confirmation of this may be found in the Migration Committee's Report, 1884, p. 53, where it is recorded that:—"During the latter half of November the rush (of Hooded Crows) seems to have been continuous night and day"—thus differing in character from the migration observed at Heligoland, which ceases about 2 p.m.; "at the outer Dowsing light vessel on November 1st, 2nd and 3rd, a continuous rush N.E. to S.W., and also at other stations;

but in less numbers to November 15th. . . ." A continuous rush N.E. to S.W. seems to point to the Scandinavian origin of this flight. As will be seen later on Mr. Eagle Clark, in his digest of all these light-house and light-ship records, has come to the conclusion that direct migration from Heligoland to our East coast only takes place on rare occasions. If the Hooded Crows seen in Lincolnshire are identical with those passing the former locality, they must reach us by a somewhat circuitous route. This is important in view of the fact that Herr Gätke bases one of his computations on the speed attained by migratory birds on the identity of these flocks.

We are not told much about the return migration of the Hooded Crow in spring; but we learn that the species passes Heligoland, travelling towards the west, in rare instances at a vast height, but usually at no greater elevation than 100 feet, and in smaller numbers than those observed in the autumn; there is also no evidence set before us to prove that the breadth of flight is so great as at the former period. There will, perhaps, not be much tendency on the part of the flocks to break up until the eastern shores of the Baltic are reached; any inclination to scatter, and thus present a broad migration front until later in the journey, would be thus avoided at the time of passage by the island.

After weighing all the evidence in favour of the far eastern origin of these great flocks of Crows, and the supposed westerly course of their flight, one is inclined to agree with Herr Gätke that the foregoing considerations have gone no further (or even so far) than to prove that they have maintained a westerly flight over a stretch of some 600 miles. But whether this is enough to justify our assuming that all these countless hosts of wanderers have regularly maintained this direction from the commencement of their migration, is, in the light of the evidence adduced, very much open to question.

In further considering the theory of a migration conducted in a broad front, we pass from the evidence afforded by a very common species to that presented by a comparatively rare one, viz., the Honey Buzzard. We are also told that this species furnishes further proof of a migration in a direction from the far

east to the far west. Whether the latter fact be true or not, the acceptance of the theory that the migration is conducted in a broad front corresponding to the latitudinal area of the breeding grounds will be found to be very difficult. Indeed, it may be at once remarked that the evidence of other observers quoted on p. 28 by Herr Gätke all points to the opposite conclusion.

The spring migration of this species, as observed at Heligoland, is described as being performed in very small parties, but in the autumn almost always in assemblages of varying numbers, but which sometimes during the first weeks of September, assume considerable dimensions. An unusually marked migration occurred on September 19th, 1858. This movement commenced with small parties in the forenoon, and increased towards sunset to one incessant stream of flocks of fifty, eighty, or even larger numbers. These approached the island from the east and disappeared from view in the far west, just as the majority of species do. Now, though this migration, as regards numbers, was abnormal and not likely to occur again for many years, yet there is no reason to suppose that it was conducted in any but the normal manner of flight. The author's theory of a broad front should, therefore, still apply, as in the case of other species.

On witnessing a phenomena of this nature, Herr Gätke might well express his wonder as to how such extraordinary numbers of an uncommon species had banded themselves together, but perhaps he had in view his theory of the "broad front" when he hazards the opinion that only the endless forests of European and Asiatic Russia could have given birth to such a throng. For we must assume, to be in harmony with the above theory, that still greater numbers were passing other localities both north and south of the island—a fact impossible of realisation in the case of so rare a species—without concurring in his remark on the necessarily vast area requisite to produce such multitudes ; and in the latter case one is also impelled to ask—What became of all this great host and in what country did its constituents find winter quarters?

Though this migration was evidently of an exceptional character as regards numbers, and perhaps akin in nature to that

of the Jay described elsewhere; it seems impossible to realise how so many of a rare species whose nesting stations must have been scattered over a wide country can have come together unless they had gradually concentrated themselves on to some customary fly line. It may be surmised that many small flocks had accumulated at some point where their further progress had been delayed by unfavourable weather. Herr Gätke's description of the flight seems to point to this—small parties at first, then larger ones, then a steady stream of flocks, and lastly the main body in one continuous procession. Had an advancing column of Honey Buzzards in a rank corresponding to the latitudinal area of the breeding range suddenly set out from the Asiatic forests to Western Europe, gradually augmenting its numbers as it progressed, it could hardly fail to have attracted notice in many parts, whereas in the present instance, Heligoland seems to have been almost the only spot where such large numbers were observed. On the theory of a direct east to west migration many of this throng should have reached the coasts of Great Britain unless a southerly turn was made soon after passing the island. In the former country, owing to the persecution meted out to all the larger birds of prey and other rare species, an event of this nature could hardly have failed to have excited remark. We know what has happened during the visitations of Pallas' Sand Grouse.

If on the other hand these large flocks had become gradually concentrated—through the configuration of the country, the following of river valleys or shore lines—into a narrow stream the chances of their escaping notice would have been vastly increased, especially as their ultimate destination seems to have been some part of North-Western Africa. It is well known that the Honey Buzzard passes the Straits of Gibraltar in large numbers every year (Irby). It is only evading the difficulty in suggesting that a further westerly flight may have been conducted at a great elevation and thus have escaped notice. It has already been pointed out in the case of the Hooded Crow; that, such a change in altitude really means, according to the author's theories, a sudden variation in meteorological conditions necessitating an ascent to higher regions of the air. That in

Herr Gätke's view this migration of Honey Buzzards was conducted in the normal way, *i.e.*, in a broad front, the following extract from his notes will illustrate. He writes, p. 29 :— "The fact that the Honey Buzzard does not reach Portugal . . . . also proves what has been already called attention to, in regard to Hooded Crows, that it is not the sight of the sea which induces birds migrating in a westerly direction to turn suddenly south, but that this deviation forms, from no accountable cause, the concluding stage of the westerly course of migration. A similar phenomenon is presented by the same bird in England. In that country the Honey Buzzard is met with as a breeding species only in solitary instances, but arrives in tolerably large numbers on the east coast during the autumn migration. *Such examples as originate from the northern limits of their breeding zone in Europe and Asia, bring their westerly flight to an early close in England, when, then turning south, they pass, viâ Western France and Spain to their winter quarters in Africa.*"

It will certainly be news to British ornithologists to learn, that the Honey Buzzard arrives in tolerably large numbers on the east coast during the autumn migration. Surely Herr Gätke is thinking of the Rough-legged Buzzard. Furthermore, to the writer, it *does* seem to be the sea that turns these northern bred birds to the south, otherwise they would reach the Shetlands, Orkneys and North of Scotland coasts rather than the east coasts of England. If taken at all the turn no doubt actually takes place in Scandinavia.

In further consideration of an east-to-west migration we may now turn to another interesting, but more common species, viz., the Shore Lark. As can be readily proved from pretty conclusive evidence, this species within the last fifty years has undoubtedly been extending its breeding range westward. In the light of this fact its gradually increasing abundance on passage at Heligoland is significant, for it is one of those species occurring in great flights to which Herr Gätke attributes a far eastern origin. With regard to its former breeding range he has collected the following facts—"According to Pallas ("Zoogr. Ross. Asiat.," pub. 1811), the bird was in

the last named year already distributed over the whole of Siberia, but in 1835 had not been met with as a breeding bird in Scandinavia." Now if Herr Gätke's contention is correct that a great proportion of the Shore Larks passing Heligoland are of Asiatic origin, as he describes on p. 32, it is a remarkable fact, bearing in mind that the species had already spread over the whole of Siberia, that this bird was at that particular period unknown as a visitor to the island. It is still more remarkable that not until *ten years* after the discovery of pairs breeding in Eastern Finmark, viz., the year 1847, that examples were met with in Heligoland in any numbers. "Since that time—adds Herr Gätke—the Shore Lark has rapidly multiplied and it has become one of the most common breeding birds in Lapland and Finmark." Some idea of its abundance in Scandinavia even as much as thirty or more years ago, may be gathered from Wheelwright's experiences. The latter observer states that during his stay at Quickiock he secured about fifty examples and could have obtained many more had he so desired.

Now what a curious coincidence must have taken place in regard to the extension of the breeding range and the migratory habits of this species—if, as soon as it had become numerous in a region lying to the north and north east of Heligoland, whence its migratory flights might reasonably be expected to carry it over the island—that the Asiatic individuals should suddenly develop a tendency to abandon their old winter quarters lying to the south or south-east of their breeding range and to seek new ones in the west or south-west of Europe; a district where we should only expect the breeding birds from Northern Europe to find a winter home. In the light of the evidence brought before us by Herr Gätke, if we accept his theory of the far eastern origin of the large flights of this species which now pass his observatory, this is really what must have taken place.

The locality of the winter quarters of the Shore Lark is involved in some obscurity, which Herr Gätke's speculations will hardly tend to dissipate. After commenting on the enormous numbers comprising the above flights which in his opinion can only be derived from a country far larger than the whole of

Northern Europe, he next calmly assigns them a winter home in the comparatively tiny area of the mountain regions of France and Spain.

Suppose for the moment we admit that Herr Gätke is correct in assuming an eastern origin of these large flights of Shore Larks, and we also try to trace their further westerly flight after passing Heligoland. We shall find, as far as Great Britain is concerned, that not until the period between the years 1860 and 1870, or ten or twelve year after the first considerable numbers were observed at the former locality, that flocks of any importance (say comprising fifteen to twenty birds) were observed on the east coast of England, though the species, in the meantime, since its first occurrence, was yearly passing Heligoland in ever-increasing abundance. It will at once be apparent that, as in the case of the Hooded Crow and Honey Buzzard, though more markedly in the present and latter species, that only an insignificant proportion cross the North Sea, as indeed is the case at the present day. If the facts were otherwise, they could hardly fail to come under observation, and it is only evading the difficulty to suppose that these individuals suddenly alter the altitude of their flight and pass over at a great elevation (see p. 367). Larks, as a rule, on migration, as Herr Gätke himself tells us, fly comparatively low, and we may take it for granted that this is especially the case in passing over large areas of land. Even if these Shore Larks really increased the altitude of their flight in travelling across England, we should expect them at times to meet with adverse meteorological conditions, and on such occasions we might reasonably look for many stragglers or even small flocks in inland localities. But up to the present time this species has been a bird of the rarest occurrence in the latter country away from the coast.

The evidence of other observers quoted by Herr Gätke (pp. 32, 366) does not lessen the difficulty of accepting the theory of an east-to-west migratory flight on the part of the Shore Lark. He writes:—"These birds arrive in East Finmark from the east and are consequently known there under the name of Russian Snow-Buntings. Collett says (see Dresser IV.) that they travel from Norway east, and thence down through

Sweden, and are seen in lower Norway only in exceptionally rare instances. In Southern Sweden they unite themselves with those coming from Asia, hence have arisen the innumerable hosts seen in Heligoland within the last decades." What evidence there is that the flocks met with in southern Sweden come from Asia, is very difficult to see; but the case of those migrating from Norway—a latitude due North of Heligoland—affords a striking instance of how easily a species migrating really north to south, or south-west, may be erroneously regarded as one performing the whole journey in an east-to-west direction, simply because, at the moment of observation, it may be passing a particular locality in the latter line of flight. It may even be the case that those individuals exceptionally met with in Southern Norway, may be identical with the birds which reach our eastern coasts, for it is difficult to see to what other country their journey, if any, further prolonged, would carry them.

There is not much to be learnt with regard to the theory of a "broad front" from the migrations of the Shore Lark, as its breeding grounds, for the most part, lie above the limits of forest growth; but Herr Gätke apparently has the idea in view when he writes respecting flocks from Asia being met in southern Sweden by others from the north of Norway. As he points out a southern turn must be taken by flocks breeding east of the Baltic, up in the far north, otherwise we should expect to find the species in greater abundance in the most northern parts of Great Britain, *i.e.*, in the Shetlands, Orkneys and north of Scotland, or perhaps still further north, away in the Faroes and Iceland. It seems, however, to be carrying the theory of a westerly flight to an absurdity in suggesting the probability of the species occurring as an occasional visitor from Europe on the Atlantic coasts of America. Herr Gätke seems to think that the Shore Lark must have displayed, even from its origin, a strong inclination for a westerly autumn migration, for otherwise, it could never have got across into Asia and finally to Lapland and Finmark. What he means by the remark "even from its origin" is not easily discernable, unless he intends to convey the idea that as the evolution of the species progressed, a supposed innate

desire to migrate westward was also developed, until it found vent in a voluntary move into eastern Asia.

It is curious to read on p. 122 that, whereas, all species in Western Europe have a strong disinclination to migrate to the east, this objection ceases to exist on the American shores of the Atlantic. The Nearctic birds are said to evince as strong a tendency to turn to the west, as Asiatic species are said to be given to migrating in the reverse direction. The northern Blue-throat occasionally appears in Alaska. Are we therefore to assume a tendency on the part of this species to migrate in the opposite direction to the Shore Lark? In the case of the latter it will be noted that Herr Gätke writes of a westerly autumn migration. It seems hardly likely, however, that a species whose normal flight must have been north to south in its original home, should have suddenly developed a tendency to migrate westwards on first establishing itself on the Asiatic continent; a proceeding more likely to have led to the extinction of the colonists than to their future increase. Is it not more probable that these first visitors to Asia accidentally found their way thither in the spring, and after having bred there, wintered in China or some country in the south-east; returning again to their new breeding homes the following year, being guided in their movements by surrounding species? In passing it may be noted that the Shore Lark breeds fairly numerously in Novaya Zemlya. A westward *autumnal* migration would hardly have colonised this locality, especially in view of Herr Gätke's theories as to the direct manner in which birds that adopt this course return to their breeding grounds in the spring (see p. 42). With regard to the latter theory, the present species so far from adopting a straight course from its winter quarters to its breeding grounds, passes Heligoland at this period in considerable numbers. Wherever these last are derived from, it is evident that their line of flight is circuitous; as in no locality so far south as the latitude of the island is the species known to nest. It is a curious fact that the Lapland Bunting, a species having a similar distribution in the breeding season to the Shore Lark should be of so uncommon an occurrence in Heligoland, especially as of late years considerable flocks have migrated to our east coast. But

the latter fact only emphasises the opinion that much of our east coast migration is quite unconnected with that occurring in the former locality. As the Lapland Bunting also breeds throughout Northern America, its spread westward has probably been accomplished in a similar manner to that of the Shore Lark. But those individuals breeding in North-Western Europe seem to have a tendency to migrate in the autumn to the south-east rather than to the south as, no doubt, was the habit of the Shore Lark until comparatively recent times.

From species having a breeding range extending throughout Northern Europe and Asia, we must now turn to two others, which have up to the present, not been detected nesting in the former continent, viz., the Yellow-browed Warbler and Richard's Pipit, to both of which Herr Gätke makes very frequent allusion. Though neither have been known to breed, on unimpeachable evidence within the boundaries of Europe, it cannot be said with truth that the full extent of their breeding areas is at all completely known.

In the case of the Yellow-browed Warbler, the late Henry Seebohm was the first to take authenticated eggs in the valley of the Yenesay, in lat. 66°. He found the birds breeding up to about lat. 68°, as we learn from his work "Siberia in Asia." Since his memorable journey little or nothing has been added, to our knowledge, of any further westward extent of its breeding range; but that the valley of the Yenesay forms the limit is very unlikely. It must not be forgotten that several Asiatic species, such as the Petchora Pipit, Siberian Stonechat, Yellow-headed Wagtail, Siberian Chiff-Chaff breed in North-Eastern Europe; the same observer having met with them in the valley of the Petchora. It seems, therefore, not unreasonable to suppose that the Yellow-browed Warbler breeds very near to, if not within, the European portions of the Russian empire. In any case, Herr Gätke is hardly justified in alluding to it as "a little East Asiatic species," or as a species from the extreme east of Asia (p. 77). The Yenesay in lat. 66° is within 700 miles of the Urals. Such a description seems to quite over-state the facts of its distribution. A similar exaggeration is apparent in the author's remarks on its occurrence in Heligoland. On p. 288 he writes:

—"The migration of this Warbler commences in Heligoland during the last ten days of September, and continues until the end of October. On several occasions the bird has been met with as late as the beginning of November." And, again, on p. 43, he further states that this bird may be met with almost daily in favourable weather during the autumn migration. From these assertions it might be inferred that the bird appeared during this period, more or less every day. But when the records of the examples shot and seen, or reputed to have been seen, are examined, it will be found that the average occurrences have not exceeded two examples per year. It is true that in certain years as many as half-a-dozen have been reported; but, on the other hand, at certain times none have appeared at all. It may also be the case that, when the species has been most numerously noted, that the same individuals have been reported more than once, as in one or two instances the records refer to consecutive dates. In any case, the average occurrence of two individuals per year, of an Asiatic species whose distribution is very imperfectly known, furnishes but little proof of a general east to west autumnal migration. As an instance of how our knowledge of the geographical distribution of these smaller species may be at fault the case of the Sedge Warbler may be pointed out. Until Mr. Seebohm visited the Yenesay valley this noisy and conspicuous species was supposed not to breed east of the Urals, except in Western Turkestan. Commenting on this fact, Mr. Seebohm pertinently asks, "Where do the Yenesay Sedge Warblers find a winter home?" No rigidly adhered to north-to-south or east-to-west line of flight would convey them to Africa, the only locality known at present. Again, even so experienced an observer as this gentleman overlooked Pallas' House Martin on his Yenesay journey. It was not until he returned home that he discovered he had been amongst thousands of this species.

The contemporary records of the appearance of the Yellow-browed Warbler relating to other parts of Europe, throw some light on the theory of migration being conducted in a broad front. According to Herr Gätke's views, the species should pass through central Europe in numbers proportionate to the vastly greater

extent of the latter country, in comparison with the area of Heligoland. That such is not the case has already been shown, and also that the numbers obtained on the island exceed the total captures for the whole of the former country. As the latitudinal area of the breeding range extends beyond the Arctic circle in the north, we should expect, if individuals from those portions of the latter exhibited a tendency to turn to the west immediately on setting out from their nesting stations, in the manner described by Herr Gätke, that the majority of the occurrences in Europe would have been recorded at points far to the north of Heligoland. As a matter of fact the evidence all points to a probable considerable flight to the south before the western turn takes place, assuming that the Heligoland examples come from such a distant region. It must not be forgotten, too, that the normal migration is from north to south; or south-east with those individuals known to nest the nearest to the European boundary. If, therefore, the examples occurring in Heligoland are derived from the Yenesay, or some region further east, and not, as is more probable, from a locality very much nearer to or within North-Eastern Russia; then the so-called westerly migration seems to be conducted in a comparatively narrow front, and not in a column at all related to the latitudinal extent of the known breeding area.

Another theory as to the manner in which these Asiatic stragglers reach Heligoland may be here advanced. It is a well-known fact that many species of birds, whose breeding-ranges are confined to the South or Central Europe, are occasionally captured many hundred miles to the north of their customary haunts. The Roller, Bee-eater, Golden Oriole, and certain warblers, may be pointed to as instances; some of them having been met with in the Shetlands, and the Oriole as far north as the Faroes. It cannot be doubted that similar straggling goes on over the whole of the Palæarctic region. There seems to be no difficulty in imagining individuals or small parties of Yellow-browed Warblers, Siberian thrushes, and others, after passing the summer in some haunts to the north-west of their customary breeding range, joining those large flights of other species whose normal migrations carry them over Heligoland.

After considering the above evidence, it may be asked in conclusion, "Does the migration of the Yellow-browed Warbler whose appearance on Heligoland is said in another place to be due to the prevalence of meteorological conditions of a peculiar nature, and therefore more or less accidental, afford proof of any value that the normal course of migration is due east to west, and that many other species having their homes in far Eastern Asia travel to their winter quarters by an identical route?

In the case of Richard's Pipit to which Herr Gätke also refers so very frequently, we have another species whose breeding-range is very imperfectly known, and we find the same tendency on the part of the author to refer to the extreme eastern limits of its known extent, as the district from which the remarkable flights passing through Heligoland are derived. To the writer there seems to be absolutely no need to assign the countries east of Lake Baikal and those bordering on the Sea of Ochotsk as the summer home of these particular individuals. Herr Gätke seems to have quite overlooked the fact that the late Hy. Seebohm found this Pipit very common at Yenesaisk, some 800 miles nearer Heligoland than Dauria and 1,600 miles nearer than the Sea of Ochotok. True, he did not take a nest, but then at the time of his visit the breeding season was over, and if it is objected that the individuals he met with were already on migration, then their presence at Yenesaisk throws considerable light on the leisurely manner in which the species performs its flights. To the writer there can be little doubt that Richard's Pipit breeds much nearer to Europe than even Yenesaisk and possibly within its boundaries, for it seems highly improbable that any species could have acquired the habit of crossing half of the continent of Asia and the whole of Europe in search of a winter home. Like the Yellow-browed Warbler, the normal course of migration in the case of Richard's Pipit is from north to south or thereabouts. Why certain meteorological conditions should effect such small numbers of the former species in comparison with the latter is incomprehensible. To the writer the prevalence of south-easterly winds at the time of migration does not afford at all an adequate explanation of the fact that only a limited number of individuals should be induced

thereby to forsake their normal course, when the great body of their fellows remain unaffected.

With regard to migrations of Richard's Pipit being conducted in a broad front corresponding in width to the latitudinal area of the breeding-range, no more telling facts against such a theory than those related by Herr Gätke could well be adduced. Remarking on the numbers of the species occurring in Heligoland, he writes (p. 118):—"Again, if twenty, fifty, or even a hundred examples of Richard's Pipit occur here in one day, these numbers can only represent a minute fraction of the quite incomputable quantity of these birds which are travelling at the same period from Dauria to Western Europe." Whatever the probabilities are of the Yellow-browed Warbler or other species being overlooked in their European winter quarters, it is quite impossible that a much larger species with a loud clear call-note and in "incomputable quantities" could escape observation in like manner. For, apart from its much greater size, the present species frequents the open country and not bushes and thickets like the former, as Herr Gätke points out. It is more, perhaps, on account of these habits and general conspicuousness, that Richard's Pipit has been so frequently observed in Western Europe than by reason of its occurrence in any supposed vastly greater abundance than the Yellow-browed Warbler. No doubt it does actually occur in larger numbers than the latter, though not to anything like the extent Herr Gätke's theories require. One also wonders what becomes of these supposed vast flocks, or in what particular country they find winter quarters. Perhaps, like several other species, they are assumed to pass over those districts where they are unknown, at a great elevation, though even under these circumstances, they might reasonably be expected to be observed on the theory of a rigidly performed east-to-west flight.

It will be interesting to compare Herr Gätke's notes on the migration of Richard's Pipit, published in another place, with the foregoing. Since the appearance of the first edition of his work—writing in the *Zoologist*, 1893, p. 164, in reply to a communication from the late Henry Seebohm—he remarks: "Widely different stands the case with Anthus Richardi, a

native of the far east of Asia, from Lake Baikal to the Sea of Ochotsk; its regular line of autumnal migration runs south, and it consequently is a common winter resident in South China and the eastern parts of India—Bengal, for instance—being in Calcutta a plentiful market bird during the winter months. *Such individuals, therefore, as under exceptional and undoubtedly meteorological influences adopt at irregular periods, though in rare instances in comparatively considerable numbers, a western instead of their normal southern autumnal migration flight, can reasonably be pronounced only accidental visitors to Europe. The more so since even the cases of appearance in greater numbers of this Pipit have occurred mostly at intervals of from six to ten years, viz., in* 1839, 1848, 1849, 1859, 1868, 1869, 1870, 1876. *On account of prevailing westerly winds A. Richardi has during the last fifteen years been obtained here but once or twice about every third year.*" The above passage is directly at variance with the statement on p. 29-30 to the effect that—"Nor must such individuals be in any sense regarded as isolated rarities or 'stragglers,' for not only are they met with regularly every autumn, but they frequently attain to the comparatively large numbers of from ten to fifty, and in two or three instances of even a hundred individuals in a single day." After the above admission that A. Richardi should only be treated as an accidental visitor to Europe, we shall undoubtedly be justified in placing a very small value on the evidence its occurrence affords, of a general migration from the far east of Asia to the west of Europe; and as this is by far the most numerous of the Asiatic visitors to Heligoland we may fairly treat the casual visits of those species, only occurring once or twice during a period of fifty years, as still more accidental.

What the many other species are from far eastern Asia which, to use Herr Gätke's own words—"visit Heligoland in such large numbers every autumn" (p. 33), one is at a loss to know.

A few words must be written on the autumnal migrations of the Goldcrest, for from a cursory examination of Herr Gätke's remarks on this species, they might appear to confirm the theory that the flight sets out from the breeding grounds in Norway in the manner he describes. There can be no doubt that the large numbers or rushes of this species which have at times arrived on

our eastern coasts are derived from the former country, as at these particular periods there has been either no corresponding rush over Heligoland, or the species has occurred there in smaller numbers than usual. Indeed it will be gathered from a remark of Herr Gätke's on p. 15, that mass migrations of this species rarely pass the island.

To enable these large flights to collect together, a certain amount of concentration on to particular stretches of the Scandinavian coast-line must of necessity take place. It cannot be imagined that all the individuals in a particular district, which might have an area of many square miles, set out from their nesting stations at an identical moment. Probably the first move is down some broad and well-timbered river valley to the sea. On arriving at the latter, the various flights are banded together whilst waiting the advent of the anti-cyclonic conditions so necessary during the migrations of so feeble a species.

On these conditions becoming prevalent the majority will probably take early advantage of the opportunity to at once undertake their flight over the North Sea. In crossing the latter, however, there can hardly fail to be a considerable amount of spreading amongst the flocks. From this fact, and also from the probability that there are many starting points, the flights on reaching our islands will affect a considerable length of coast line. Moreover, all do not proceed directly inland; many will continue the journey by following the latter to the south, and as these rushes occasionally extend over a period of several days, flocks which have really arrived in the north, and have since travelled many miles further, may come to be regarded, in other localities through which they may pass, as new arrivals from over the sea. Thus so far from having conducted the migration in a broad front corresponding to the latitudinal area of the breeding grounds, the flight has been really performed in several narrow columns, which have become partially dispersed in crossing a wide sea.

Herr Gätke in later chapters of his work alludes to large flights of Plovers, Curlews, Godwits, Sandpipers, Oyster-catchers and other species occurring late in the year, at times quite beyond the ordinary migration period of these species. These supplementary migrations are usually accompanied by the advent of severe

weather. In the manner of their performance, however, they do not differ from the flights at the normal periods of the year. These individuals, moreover, have long since left their nesting stations, and there can be nothing suggestive of a broad front corresponding in breadth to the latter, in the manner in which these late birds pass the island. Why, therefore, should Herr Gätke conclude that the latter mode of flight is characteristic of the migrations of the same species which take place in the ordinary course, but which do not visibly differ in the manner in which they are conducted from those under notice.

As further evidence of, and in confirmation of his theory of an east-to-west autumnal flight, Herr Gätke frequently refers to the observations of a well-known ornithologist, viz., Mr. John Cordeaux, a gentleman living near the Lincolnshire coast in a locality almost due west of Heligoland, and whose opinions he, in common with all naturalists, holds in high respect. As an example, on p. 26 he writes:—"Mr. John Cordeaux . . . . informs me that the bands of migrating Hooded Crows do not alight immediately upon reaching the coast, but continue their journey inland in a westerly direction," and other notes to the same effect. That the latter gentleman, however, does not intend his remarks to apply to all immigrants arriving on our east coast may be readily shown from his writings in other places. Referring to two great rushes of birds in 1892, comprising Redstarts, Whitethroats, Robins, Pied and Spotted Fly-catchers, Wheatears, Hedge Sparrows, Goldcrests, Grey Shrikes, Larks, Ring Ousels, Blackbirds, Redwings, Thrushes, Willow Wrens, and a few others, he remarks:—"In both these cases of great rushes, which I have cited under similar meteorological conditions, great flights of immigrants were evidently passing the North Sea, probably from north-east to south-west, when the easterly gales caught them on the flank and drove them helter skelter on to the east coast" (*Zool.*, 1892, p. 420). And again in the same journal (p. 227, 1893) he expresses the opinion that the migratory Rock Pipits which visit the east coast in the autumn are almost exclusively the Scandinavian form from the north-east.

Still more to the point are further remarks bearing on the ques-

tion of an east-to-west flight, which appeared in *The Naturalist*, 1894 (p. 420). He writes: "As a rule the small summer visitants to northern and central Europe, such of them as reach the coast of Great Britain in the autumn passage, do not pass inland or cross the country, but follow the coast line south. This is the case with the Ring Ousel, Wheatear, Redstart, Willow Wren, Pied Flycatcher, Yellow Wagtail, and a great many other small species far too numerous to mention, and so much is this the rule that an observer residing a few miles inland will be ignorant of the immense movement going forward within so short a distance." The latter remark also throws some light on the question of migration in a broad front.

The above extracts will be sufficient evidence to prove that Mr. Cordeaux fully recognises a strong migratory movement travelling between the points of north and north-east to south and south-west, and that the opinions expressed in his writings referred to by Herr Gätke are only to be applied in a limited sense.

Further references to the opinions expressed by the same gentlemen, that many of the migrants arriving in north Lincolnshire from over the sea reach the latter locality from a due easterly direction, though somewhat contradictory to those previously quoted, may possibly be explained in the following manner. Birds crossing the North Sea from north-east to south-west, on first catching sight of the land when out at sea, will very probably so alter the course of their flight in order to reach it as early as possible, as to give an observer the impression that they are coming in directly from the east.

Mr. W. Eagle Clarke, however, on whose shoulders has fallen the labour of digesting the immense amount of material furnished by the observations of light-house keepers and others—at the instance of the Committee appointed by the British Association to study the question of migration—has expressed himself very decisively on the supposed identity of the migration over Heligoland with that affecting our east coasts by a direct east-to-west flight. On p. 7 of his digest he remarks: "Much prominence has been given in some of the Annual Reports issued by the Committee, and in Herr Gätke's book, 'Die Volgelwarte Helgo-

land,' to an inter-migration between Heligoland and the east coast of England by a direct east-to-west autumn, and, it is to be presumed, west-to-east spring, movement. Herr Gätke most obligingly communicated details of the bird movements observed on Heligoland for four years (1883-1886), during which the inquiry was being prosecuted over the British area. These two sets of data have been carefully examined and compared, and it has been found that the dates of the chief movements of the species common to Heligoland and eastern Britain seldom, if ever, correspond, and do not bear out this theory; that particular species which are irregular as migrants in Britain, such as the Ortolan Bunting, and others, occur regularly, often indeed in 'rushes' at the more favoured isle off the mouth of the Elbe; that other species which are very rare on our British shores occur in Heligoland as regular migrants and in considerable numbers, as Motacilla flava, Anthus Richardi, &c., while species common to both islands occurs in 'flights like clouds,' in 'hundreds of thousands,' thousands upon thousands,' in 'marvellous numbers,' 'astonishing flights,' and so on, at Heligoland, at periods when there is not a single observation for the same species on the English shores. A study of the phenomena of migration compels the investigator to come to the conclusion that Heligoland and Britain draw their migratory hosts from different sources."

Mr. J. H. Gurney has been at some considerable pains in drawing up a comparative list of the occurrences of certain species which have arrived at various times on Heligoland and on our east coasts in exceptional numbers, and whilst the result might appear to some extent to confirm the view that a close connection exists between the migratory streams affecting both localities, still he does not fail to point out that in the greater number of instances there is no connection whatever. Mr. W. Eagle Clarke further expresses the opinion that as "the ordinary movements of any common migratory bird occur in each month of its seasonal flight-periods, and the mere coincidence of the species being observed simultaneously in *ordinary numbers* on both sides of the North Sea, has no significance whatever. It is not impossible or improbable that birds may *occasionally* cross the German Ocean by an east-to-west flight in the latitude of

Heligoland, but our data lead us to believe that such cases are the *rare exception*, not the rule." According to the same gentleman, the records kept at the Outer Dowsing Lightship, the most isolated of the stations in the North Sea, situated thirty-eight miles E.S.E. off the mouth of the Humber, or almost in the exact latitude of Heligoland, strikingly confirm this opinion.

It is difficult to see on what grounds Herr Gätke has based his theory that the general course of migration trends from east to west. Apart from his own observations conducted on Heligoland he brings forward very little confirmatory evidence. He, however, in one place refers to a statement of the late John Wolley's as furnishing the most northern illustration of an autumn migration proceeding in this direction. It appears that the latter observer, after only a year's residence at Muonioniska, in lat. 68° N., came to this conclusion on account of the large numbers of the Yellow Bunting he met with at the close of summer. These, in his opinion, could only have come from a district lying to the east. Mr. Seebohm, however, considered this species rather rare in the Petchora district; whilst Collett states that even in the extreme north of Norway a few individuals remain throughout the winter ("Bird Life in Arctic Norway"). If follows, therefore, that the present species is an abundant summer migrant in the latter locality. Herr Gätke, however, even in this instance, is constrained to admit that the further course of migration on the part of this Bunting must be to the south, otherwise it should visit the Shetlands in large numbers, whilst the reverse is actually the case. Compared with the distance travelled in the latter direction any westward flight, which, moreover, would be hardly likely to comence further east than the shores of the Kola Peninsula, is very trivial.

Herr Gätke also calls attention to the presence of countless droves of land birds, both of the larger and smaller species, as well as of Ducks, Geese, Swans, and other water birds, which may be seen in the autumn months on the coasts and interior parts of the west of Scotland. All these, he states, are hastening to their winter quarters in a southerly or south-south-easterly course. This may be true of the land birds, not only at that particular time and locality, but may equally well refer to the whole

journey. It is difficult to see what evidence there is to show, however, that these droves consist in part of birds which, like the Brambling, after arriving on the east coast, have traversed the latter country in a westerly direction. The flight of these flocks, according to the evidence afforded by the observations of light-keepers and others, either still maintains its south-westerly course, or follows the eastern coast line into England.

With regard to the Brambling. The movements of this species from Northern Scandinavia are said to first conduct them to the southern parts of Sweden. Possibly this is correct, but that they then turn directly west is very doubtful. It will be evident if they merely follow the general trend of the land their course must necessarily be to the south-west, and if again they leave the coast of Norway at its most westerly extension, this same direction of flight need merely be still maintained to eventually land the travellers on the mainland of Scotland, and not on the Orkneys and Shetlands.

Herr Gätke, however, has quite overlooked the presence of many migratory species in the Faroe Isles, and still far greater numbers in Iceland. It is absurd to suppose that birds from either of these localities migrate in autumn to the west. It therefore naturally follows that the hordes of water-fowl and shore-birds observed on the west of Scotland must in great measure be derived from these northern islands, and not from districts in the north-east of Europe, as he supposes. When, however (p. 31), he is driven, in support of his theory of an east-to-west line of flight, to allude to the fact of the Gannet having been observed passing in a westward direction for six or eight days together at Cape Wrath, its weakness will be apparent; for it is well known that no breeding places of this species exist to the east of Scotland, the movements in question being merely due to wanderings in search of food.

It is on evidence of this nature, and in conjunction with his own Heligoland notes, which have already been discussed, that he bases the assertion that "the flight of these migrants has thus been followed from Eastern Asia to the Atlantic shores of Europe. In the case of the most different species, and in districts so widely separated as Central Germany, Heligoland, the

eastern coast of Great Britain—including the Orkney and Shetland Islands—Norway up to a latitude of 70° N. in Finmark, the same results as to the direction of the migratory flight have been obtained."

Why certain species should follow such a course, and the remainder should fly from north to south, he offers not a word in explanation, and he quite ignores the results of inquiries conducted by ornithologists like the late Dr. Severzoff, as regards Central Asia; and Dr. Menzbier as regards Eastern Europe; or, again, by Von Middendorff, who, after selecting seven typical species, found that in the middle of Siberia the general direction of the usual migrants is almost due north, in the east of Siberia from south-east to north-west, and in European Russia from south-west to north-east. Prof. Palmen's conclusions are similar. Whether we accept the theories of the latter as to the manner in which birds are guided, or not, is of little importance at the present juncture, and does not affect the accuracy of his statements on the direction of the migratory flight.

It is no doubt true, as pointed out by Dr. Menzbier, that there are no such things as fly-lines. Probably every species goes its own way, and what is called a migration route is only the coincidence of the way taken by many (Newton, "Dictionary of Birds"). How Herr Gätke, however, can formulate a theory of a migration carried out in a broad front, corresponding to the latitudinal area of the breeding-ground, and rigidly conducted in an east-to-west direction, in the face of the heterogeneous assemblage of individuals and species which pass with such regularity and in such wonderful proportions at his little island, is impossible to imagine. With regard to the confirmatory evidence of a general migration in an east-to-west direction, afforded by the capture of a few Siberian species during a period of more than fifty years, as well might it be argued, from the occurrence of over 250 American birds in Great Britain in the same lapse of time, that the general tendency of migration in the latter continent is in the reverse direction.

In objecting to the theory that birds follow coast lines as guides during their migration, Herr Gätke, referring to Richard's Pipit, and others, inquires—"Are we, therefore, to assume that

when arrived at the Baltic they suddenly become incapable of continuing their journey except by following the comparatively small span of coast to Holstein?" To this one might fairly retort—Are we to assume that, because birds in passing Heligoland are either seen or heard to be travelling in an east-to-west direction, that this is the course of flight maintained throughout the whole duration of their journey?

We turn now to the consideration of Herr Gätke's remarks on those species which he tells us travel to and from their breeding-grounds in a direct north-to-south, or the reverse, line of flight. There will not be the difficulty in accepting his conclusions as to the general direction of this flight as in the previous case, but exception must be taken to the assertion that it is performed in the rigid and undeviating manner as described; and also to the theory that it is conducted in a broad front, in a similar mode to the east-to-west flight.

In considering Herr Gätke's arguments, his admission that not a single bird is seen to arrive at or depart from the island in either a north or south direction must not be forgotten. Yet he tells us that this north-to-south line of flight is "peculiar to a large number of species, more especially such as have their breeding-quarters in high northern latitudes, and, in respect to the individuals taking part in it, fully equals the great east-to-west migration, while, as regards the distance traversed, it in many cases even surpasses the latter movement." We are, therefore, driven to the conclusion that it is the consideration of the breeding-ranges of the species which are said to comprise this movement rather than the result of actual observations on which he bases his theory. One is rather puzzled to know what species are comprised in this flight, as, on pp. 25 and 30, several having their breeding-grounds in the high north are included in the list of those said to be derived from the far east; others such as "the Bluethroat, Wagtails and Warblers—we are told—appear on and depart from the island in a manner precluding the possibility of our being able to realise by our senses the direction of either their arrival or departure."

Amongst the species specially singled out in illustration of this north-to-south flight is a very well-known one, viz., the

Red-spotted Bluethroat. Referring to its geographical distribution Herr Gätke writes :—" This species breeds in high northern latitudes of the old world from Kamschatka as far as the central and northern portions of Norway, while its winter quarters range throughout the whole of Southern Asia and over the eastern half of North Africa." It may here be pointed out that most authorities refer to Egypt as the winter quarters of the Northern Bluethroat, as Herr Gätke himself does in other places. This point is of importance in view of the fact that Herr Gätke makes such special reference to the undeviating character of the flight. As the latter part of North-eastern Africa is the only locality where this species is found in winter, it is difficult to see how a rigidly performed south-to-north flight would cross Heligoland at all. He further adds:—"In Heligoland, as well as in Germany and Italy, it is of quite regular autumnal occurrence; in England, on the other hand, only solitary examples of the bird have ever been met with, and these only at intervals of many years . . . ." With regard to the latter remark, Herr Gätke's information is certainly not up to date, for he quite overlooks the occurrence of the species in North Norfolk where over a hundred were observed at one time. In the opinion of Professor Newton, the Bluethroat probably occurs on our east coast with regularity, but is, no doubt, overlooked ("Dictionary of Birds"). Reference also to Mr. Cordeaux's notes in the *Naturalist* will prove that hardly an autumn passes without one or two being observed in the Humber District; other occurrences are alluded to in the reports issued by the committee on the migration of birds. It has also been recorded from Malaga and Valencia in Spain (Irby). One cannot help speculating whether, if Herr Gätke had not overlooked these facts, he would not have been tempted to include the Bluethroat amongst the species migrating by the east-to-west route, for its distribution is very similar to that of several species comprised in the latter. His following remarks will afford good evidence, after noting the above omissions, of the danger of attributing a rigidly-maintained direction of flight to any species whatever. He writes :—" It hence follows most decisively that the bird, in autumn, rigidly adheres to a southerly course of migration

and travels in a broad migration front which corresponds to the longitudinal range of its nesting area, and of which Heligoland forms the most western limit. Even a slight westerly deviation from their southerly course of such species (individuals?) as breed in the west of Norway could not fail to convey large numbers of these birds to the east coast of England, and their all but total absence there furnishes, therefore, an undoubted proof of the persistence with which the southerly course of migration in this instance is adhered to." It has already been pointed out that the Bluethroat is not of so casual an occurrence in England as Herr Gätke supposes, and if we bear in mind that the winter quarters of this species in North-eastern Africa are limited almost to Egypt, it becomes evident that the individuals breeding in the westernmost parts of their range would, on their return journey, if they took a direct route, fly from north-west to south-east. The pretty regular appearance of examples in England is, therefore, still more worthy of note. One would naturally expect the species to occur fairly numerously in central Europe on the return journey, owing to the proportion of young birds which would then be travelling, and also on account of the more leisurely manner in which the latter flight is conducted. But, judging from the evidence placed before us, it appears to be rather local, even in this large area.

The difficulty of accepting the theory of a migration conducted in a broad front is perhaps more apparent in the case of the Northern Bluethroat than in any other species to which Herr Gätke refers. Writing on the spring flight he remarks (p. 265): "In the absence of cold and dry northerly winds at the end of May and April, it appears here [*i.e.*, Heligoland], as a daily visitor, and if, in addition, the weather be warm and fine, with a light south-east wind, it frequently occurs in such large numbers that on days of this kind Oelrich Aeuckens and myself have succeeded in obtaining as many as from thirty to fifty male individuals." He also tells us (p. 44) that on May 26th, 1880, the species occurred on the island in thousands. In certain preceding passages Herr Gätke lays special emphasis on the fact that the Northern Bluethroat has only been obtained during its spring

flight, in very exceptional instances, in Italy, the north of Germany, and in other localities south of the latitude of Heligoland. This he regards as strong evidence of the unbroken character of the flight. But may not these facts be quite as reasonably cited in evidence of the narrowness of the migrating column? The paucity of observers in south Europe, too, must not be overlooked. Herr Gätke seems to be quite certain in his own mind that the Bluethroats passing his observatory in spring are identical with those which breed in western Norway. To the writer, however, the evidence is all against the accuracy of this assumption. In the first place we are confronted with the remarkable fact—if such were the case, and if the assertion is correct that these Norwegian individuals occupy the extreme westerly extent of the advancing column—that it is only the latter individuals that take a rest during their flight, though they have the shortest distance to travel. This is a curious circumstance in view of the statement that the Bluethroat migrates at the rate of 180 miles an hour, and also that by the time it reaches Heligoland it is rapidly nearing its destination in western Norway. Furthermore, this rest appears to be taken at times when the meteorological conditions are most favourable to the performance of an unbroken flight, *i.e.*, during the prevalence of light south-easterly winds with warm weather. If the species migrates in a broad front, how do those individuals dispense with a rest who must, of necessity, travel over the whole length of the Baltic and Gulf of Bothnia, if they rigidly confine their flight between the points of south and north? One cannot help here remarking on the inconsistency of Herr Gätke's arguments. In the case of the Shore Lark and Hooded Crow, we are told the vast hosts which pass Heligoland can only be derived from a country extending from the Atlantic to the Pacific, but in the present instance, a species, which has always been looked upon as only moderately common, occurs in thousands on one day alone, viz., May 26th, 1880, and, moreover, on a tiny island. In the face of these facts we are asked to believe that these large numbers are journeying north to breed in a very limited area in the most southern and western extension of the breeding range. Does not the above evidence point in a far stronger manner to

the fact that the Northern Bluethroat migrates—at any rate in spring—in a very narrow column or columns, and bearing but little relation to the extent of the winter quarters and breeding range? Shall we not also be much safer in assuming that the large numbers occasionally noted on the island late in May are individuals breeding in the far north? We should expect those whose nesting homes lie in the most southerly portions of the breeding range to have already commenced operations by May 26th. Even in the Petchora valley, Messrs. Seebohm and Harvie Brown note that the Bluethroat arrived in this northern locality quite a week earlier. Again, the winter quarters of the Bluethroat in north-eastern Africa are very much more confined in latitudinal extent than are the breeding grounds in northern Europe, so that there must be considerable spreading of the flocks, and, consequently, no rigidly adhered to, south-to-north direction of flight during the spring migration, if conducted either in many narrow, or in one broad column. To the writer there seems to be little doubt that the Bluethroats calling at Heligoland during May form a succession of flocks travelling in a narrow flight over a customary route to breeding grounds in the north of Scandinavia and Lapland, and that their non-appearance in certain years is due to a deflection of the stream which may readily miss so tiny an area as the island, or even break the journey at other points. The fact of individuals so rarely occurring in intermediate localities, though surprising in itself, is much less difficult of comprehension on this theory. Herr Gätke himself perhaps gives a clue to this mystery in his charming opening words, referring to the progress of migrants, where he speaks of our "sharing in their joy when some high mountain valley offers a portion. . . . . some temporary rest and refreshment" (p. 3). But the paucity of observers in southern Europe must by no means be overlooked in accounting for the absence of spring visits of this species.

As before noted, Herr Gätke does not devote much space to the consideration of the autumnal flight of migrants which pass from north to south. In addition to the Bluethroat, however, he refers to a few other birds. Amongst the latter is the Red-throated Pipit, a species breeding abundantly above the Arctic

circle from Norway eastwards; but whose winter quarters lie to the south-east, rather than the true south, of Heligoland. Colonel Irby, however, met with two examples at Gibraltar, and expresses the opinion that it passes that point regularly on migration.

Referring to the geographical distribution of this bird, Saunders writes—(Manual of British Birds):—"It breeds in many parts of Scandinavia, especially in East Finmark; while eastward we find it in increasing numbers, beyond the limits of forest growth, across Siberia to Kamtschatka and Bering Island. It is even said to have straggled across the Pacific to Lower California; but, be this as it may, the migrations of this Pipit undoubtedly extend to southern China, Borneo, Burma, India, Persia and Egypt. In the latter and in Nubia the bird is exceedingly abundant in winter; westward in North Africa it becomes rarer; but it is found on migration throughout the basin of the Mediterranean from Asia Minor to Gibraltar."

This Pipit from its similarity to A. pratensis is very likely to be overlooked. This view is strengthened by Herr Gätke's further remarks. With regard to its occurrence on Heligoland, he writes:—"I obtained the first example of this Pipit on the island on 28th September, 1854, and the second on 20th September, 1857. Soon after, Claus Aeuckens learned its call-note, and in consequence managed to see and frequently shoot one or other of these birds regularly every autumn. In 1884 they occurred here in unexampled frequency; from 15th to 30th September thirteen examples were seen, and for the most part shot, on some days as many as three examples" (p. 345).

The above account, however, will be found to be quite at variance with a reference to this species on p. 37. In the latter place the author writes of the Red-throated Pipit as only occurring in Heligoland in the most exceptional cases, having only been shot there more than six times within the last fifty years. The latter fact having been brought forward as evidence of the extreme rigidity with which the north-to-south line of flight is adhered to, its value will be apparent when compared with the previous statements. The admission, too, that as soon as one of Herr Gätke's best assistants became acquainted

with the call-note, the species should be noted afterwards as of regular occurrence, is significant, and points to the fact of its having been previously overlooked. The same has probably been the case on our east coasts. So experienced an observer as Mr. Cordeaux has expressed the opinion that it would be almost impossible to detect the Red-throated Pipit amongst a flock of Meadow Pipits even with the aid of a good field glass. Furthermore, in various parts of the text the author includes *A. Cervinus* amongst those species which are brought forward in evidence of an east-to-west line of flight (p. 116). It is odd to read, therefore, that it "likewise adheres to a most rigid southerly course" in its autumn migrations.

In considering the migrations of this species Collett remarks:—"Like most of the genuine migrants of the order Passeres, the small birds do not reach their northern nesting-places across the southern parts of Norway, but by the eastern route across Russia and the Baltic provinces. One consequence of this is that the Red-throated Pipit and Siberian Willow Warbler are either not met with at all during migration in the southern parts of the country, or appear there only occasionally and accidentally" ("Bird Life in Arctic Norway").

Turning now to two other species singled out by the author, viz., Eversmann's Warbler (*Sylvia borealis*) and the Northern Nightingale (*Sylvia philomela*) we find that the former of these is stated "to direct its migration flight in an equally unswerving southerly line." Unfortunately but little of the winter distribution of this tiny species is known, but it seems to be identical with that of the Red-throated Pipit and several other species breeding in Northern Europe, lying rather to the south-east than the true south of the western limit of the breeding range. In whatever manner the migration is conducted it will trend in the former direction, and the chances of the species turning up in Heligoland are thereby much reduced. Writing on this species, Collett remarks:—"In Finmarken it is a recent immigrant, and its migrations therefore do not pass southwards along the Baltic provinces, like that of our other Arctic small birds, but it migrates across the large river basins of Siberia, in order to reach down to the Pacific Coast, China and India, where its chief winter home is" ("Bird Life in Arctic Norway," p. 30).

The absence of records from neighbouring countries points rather to the fact that the flight is conducted in pretty compact flocks and not in a broad front. If the latter were the case, more straggling might reasonably be expected. In this instance, apparently, the author does not apply the rule that the species should occur in numbers proportionately greater in Central Europe as the size of the latter area is to that of Heligoland, though to be consistent he should do so. He does not even suggest that Eversmann's Warbler has been overlooked in other parts. This is a fair example of the varying treatment identical evidence, in support of divergent theories, receives at his hands. The very casual appearance in Heligoland of the Northern Nightingale is not difficult to account for; the breeding range of this species extends but little further north than the latitude of the island. On leaving their nesting stations in the autumn, migratory individuals are far more likely to deviate from their normal course in the middle or latter part of their journey than at its commencement. It must not be forgotten, too, that as the limits of the breeding grounds are approached birds become much scarcer than in the central portions. In the present case an early westward deviation of Swedish individuals would be far more likely to be observed on the coasts of Denmark, where such stragglers would probably unite with local examples of their own species. It may be further remarked that the single record of the Northern Nightingale in Heligoland was noted on the night of May 4-5 at the lighthouse lantern. It seems quite possible that this was an individual which had overshot its breeding grounds in the Rhine Valley, where, according to Seebohm, the species occasionally nests.

The remaining species alluded to by Herr Gätke as conducting their migrations strictly between the points of north and south, viz., Siberian Chiff-Chaff, Yellow-headed Wagtail, Yellow-breasted Bunting, Terek Sandpiper, and Red-footed Falcon, are all birds having their winter quarters for the most part in the south-eastern portions of the Palæarctic or oriental regions; and their breeding ranges extend but rarely any distance further westward than long. 25° E. It would therefore require a very considerable deviation from a direct southerly flight to carry individuals over

Heligoland. Still for all that, such a contingency occasionally happens in the autumn months. In such instances the explanation, to the writer, seems to be that these stragglers have accidentally attached themselves to flocks of other species whose ordinary flight passes the island.

In the case of the Yellow-headed Wagtail, it may be remarked that up to the present this species has not been found breeding west of the valley of the Petchora. That it should have occurred on migration no less than five times in so distant a locality as Heligoland is remarkable, and forms additional proof that many of the migrants—which according to Gätke, are derived from the east—really come from northern and north-eastern regions.

The above remarks also apply to the Siberian Chiff-Chaff and Yellow-breasted Bunting; though their breeding ranges extend further west. The latter species, it may be noted, has occasionally been found in Southern Europe.

As an exception to the rule of a migration rigidly performed between the points of north and south, or rather in accounting for the regular appearance on Heligoland and in other parts west of the ordinary limits of such a flight, Herr Gätke makes especial reference to the Little Bunting. On page 34 this species is said to migrate in a direct north-to-south line of flight, but later on in his work the author includes it amongst those which are supposed to migrate westward from Eastern Asia. On page 34 he remarks: "More or less considerable numbers of individuals turn to the west on quitting their nesting stations, and migrate to Western Europe instead of Southern Asia." He further adds: "This tendency is by no means peculiar to those species whose breeding range extends to Western Asia or North-eastern Europe, as is proved by the cases of the Siberian Chiff-Chaff, the Yellow-breasted Bunting, and the Terek Sandpiper. On the contrary, all our experience goes to show that it is more especially manifested by species whose breeding homes are furthest removed from Europe. . . . Moreover this tendency is generally confined to particular species only of a genus, being entirely absent in others of the same genus. In proof thereof we may cite the case of the Yellow-breasted Bunting and the Little Bunting—two species breeding in the north-east of European Russia, whose

nests may be found almost side by side. Of these the former has only been seen in Heligoland on three occasions within more than fifty years, and with the exception of an example met with at Genoa, has never been observed in Central or Western Europe. The Little Bunting, on the other hand, appears in Heligoland every autumn, and is frequently shot. . . . In the south of France it is said to be the commonest of the rarer Buntings, small companies of it wintering at Marseilles. [He might also have added that nine examples were obtained near Malaga, in Spain, December 28, 1874 (Irby)]. Inasmuch, then, as both species are found breeding in about equal numbers in the neighbourhood of Archangel, both, too, belonging to the group whose autumn migration is directed south, we are confronted by the question as to what may possibly be the cause which determines the one—the Little Bunting—annually in large numbers to turn west on starting from the common nesting home, while the other—the Yellow-breasted Bunting—is hardly ever induced to swerve in this manner from its normal southerly course."

After reading the above and comparing it with further remarks on the Little Bunting in other parts of the book, one is somewhat puzzled as to whether Herr Gätke intends we should gather that the Little Buntings met with on Heligoland are supposed to be derived from the neighbourhood of Archangel, or from far eastern breeding grounds in Asia. If from the latter locality, then, according to the author's treatment of other species, their flight would come under the category of an east-to-west description, and not, as previously stated, of a north-to-south type. A reference to the records of the Little Bunting on Heligoland seems to point to the fact that the individuals touching there are derived from two districts, as there is a break in the continuancy of migration, not a regular dribble of individuals during the autumn as with other species. As the species breeds throughout Northern Russia, east of the White Sea, it may perhaps be the case that the later arrivals come from the Petchora, or other river valley in the north-east. In any case there is no evidence of a flight rigidly performed either from east to west or north to south, though the general direction appears to be from north-east to south-west, or thereabouts.

Herr Gätke seems to think that the appearance of certain species on Heligoland, whose breeding grounds for the most part lie in Asia, is due either to an innate tendency to wander, or to a deliberate turn to the west on setting out on their migrations. In other places, however, it must not be forgotten that he attributes this westward wandering to meteorological influences prevailing at the period of autumnal migration. If the former supposition is correct, it is difficult to see how this tendency has been inherited without producing a more general effect on the particular species which are said to be subject to its influences. It is significant that those which are supposed to be so affected have, as Herr Gätke admits, for the most part only been detected on the island in single instances; but as the Yellow-breasted Bunting and Yellow-headed Wagtail have occurred more frequently, it is remarkable that he has not brought them forward too in illustration of this tendency rather than treating them as species, which prove how rarely a certain other group of birds deviate from a rigidly performed north-to-south flight. The probability of the fact, that because certain species have occurred on Heligoland in small numbers, therefore they should in like manner occur in much larger numbers in Central Europe, seems to the writer to depend entirely on our acceptance of the theory that birds migrate in a broad front. Whether this is so or not, it seems very unlikely, however, that the small number which are apparently induced to travel westward should adopt such a form of migration.

With regard to the progress of the spring migration from south to north, Herr Gätke's remarks are very interesting, and form a striking example of how the habits of birds differ in various localities. On page 41 he writes:—"Here we nowhere meet with any attempts at dividing the long migration flight into short convenient stages such as is often the case after the first great advance during the autumn migration; nor do the birds at this time anywhere exhibit a tendency for taking long spells of rest in the course of their journey. Unrest and an impelling haste are everywhere the prominent characters of the movement during its whole progress." Observations conducted on Heligoland no doubt bear out this statement, and we can hardly imagine

birds lingering at such an uninviting spot—especially uninviting in the spring—unless their need for food or rest were very urgent. But in other localities the observations of naturalists point to quite a different conclusion. In our own country, for instance, at various points on the east coast, certain species make their appearance with great regularity at particular times, and so far from evincing any of this unrest and impelling haste, are content to linger for days together before further continuing their journeys.

The Fieldfare may be singled out as a species illustrating this fact; even those flocks which pass through the Midlands at so late a period in the spring as the first week in May, so far from exhibiting any of this restless haste, may be seen lingering in the same fields for several days at a time, instead of at once passing on. The case of the Dotterel—a species breeding in the far north of the Palæarctic region—too, is similar, flocks of which are known to tarry in certain districts, not for days, but for whole weeks together. Again, at Gibraltar, Col. Irby as early as March 11th met with very large numbers of the Common Crane migrating due north. In the course of a single hour he calculates that at least four thousand must have passed by. As the Crane breeds only very locally and very sparingly in Spain, there can be no doubt that these flocks were *en route* to the north of Europe. But at this period their breeding grounds would not be fit for habitation. No doubt the journey would therefore be broken at some convenient locality in Western Europe. To the writer the very fact of so vast a number of birds visiting a little spot like the island which Herr Gätke describes as a most unattractive residence for birds, points to the probability that the greater number—certainly of the smaller birds, if not the larger—also conduct their migrations in comparatively short stages. The fact of the greatest number calling during periods which we are told are the most favourable to an unbroken flight—viz., the prevalence of warm weather with light south-east winds—seems to lend additional force to this conclusion. The central position alone of Heligoland does not afford satisfactory proof that this is the true reason why the island is so exceptionally favoured as a place of call by so many species. For, on Herr Gätke's theory of migration, conducted in a broad

front, the neighbouring islands should be equally patronised. Indeed, the position of Heligoland can hardly be called central, except in relation to Western Europe, and with reference to a migratory flight between the points of north and south. Another point may be noticed with regard to the spring migration to which Herr Gätke calls attention, viz.—the much smaller number of certain species which pass the island at this period of the year. This he accounts for on the theory that birds travelling from their winter quarters to their breeding grounds take the most direct route possible at this period of the year. The majority, therefore, traverse lines of flight passing much to the east of the island, and generally speaking, in a south-westerly to north-easterly direction. Ingenious as the theory may be, it is quite unsupported by any positive evidence, and is in direct conflict with the author's assertion, expressed on page 25, that, observations conducted on the island have established the main facts that in autumn the migration is from east to west, and in spring from west to east. As an instance that all birds do not return in spring by the most direct route to their breeding grounds, the Shore-Lark may be pointed out. This species passes Heligoland at this period in considerable numbers by an apparently west-to-east route, though its breeding grounds lie far to the north of the latitude of the island.

To the writer, the great mortality which must of necessity take place amongst birds, affords a much more probable explanation of the fact of the smaller number of migrants being observed in the spring. If we only reflect what the numerical increase of, say, 100,000 pairs of birds would amount to in a few years, allowing four young as the annual production of each pair, and the young themselves breeding the following year, it is at once evident that a single species would soon over-run the whole earth, unless some check on its constant increase were not always in action.

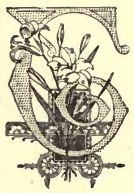
The position of the island may here, perhaps, lend an additional explanation of the fact of fewer birds being observed in spring. In the autumn many species will be nearing their winter quarters, and consequently travelling very slowly and lingering in any locality likely to afford rest and refreshment;

but in the spring many, on the other hand, will only be just starting on their journeys, and consequently not so urgently in need of food and rest. Even the author's own theory that at the latter period birds "perform their journey from their winter quarters to their breeding-grounds, if possible in one uninterrupted flight" (p. 44), would lead us to expect fewer callers on the island at this season than in the autumn.

With regard to the return of Siberian species, whose presence on Heligoland is said to be due to the peculiar influence of certain meteorological conditions prevailing at the time of migration, it can only be suggested that as they have been led so much astray by these causes, it is very doubtful, if they are ever capable of finding their way back again to their proper breeding-grounds. Most probably those which survive the dangers of winter join parties of other species journeying to the north of Europe, where the chances are very much against their ever finding a mate.

In conclusion, the migration of several species whose breeding-grounds are in the far north, such as the Knot, Sanderling, Curlew and Pectoral Sandpiper, &c., may be pointed out as evidence quite at variance with the theory that their flights are conducted in a broad front. In a small area like that of the British Isles, where the distance of the central portions from the sea is so insignificant, all these species are of the rarest occurrence inland; whilst on the coast-lines, more particularly the eastern, several of them are very abundant. The same is the case in other parts of the world, and it is only in the great river valleys, such as that of the Volga, that they are met with in any regularity. The Knot, however, though very abundant on the Atlantic coasts of America, is almost unknown inland, even in a great river valley like that of the Mississippi. All these facts are quite contrary to what might be expected were migration performed according to the theories of Herr Gätke.

ALTITUDE OF THE MIGRATION FLIGHT AND METEOROLOGICAL CONDITIONS WHICH INFLUENCE MIGRATION.



HOUGH Herr Gätke has devoted separate chapters in dealing with his observations on the altitude of the migration flight, and the meteorological conditions which influence migration; to the writer it seems a better plan to discuss both features together, as they appear to him to be so closely connected; and it is also stated in many places by Herr Gätke that the height of the flight is governed by the prevailing weather.

His opening words in Chapter III. are very important, as they define his views of the normal height and manner in which migration is performed. He remarks:—"Observations extending over many years have led me to the conclusion that, as long as migration proceeds under its normal conditions, this elevation is, in the case of by far the larger number, so great as to be completely beyond the powers of human observation; while we must regard as disturbances and irregularities of the migration movement proper, due to meteorological influences, such portions of it as are brought within our notice. Here I ought to remind the reader that when I speak of migration proper I mean those large extensive movements which, on the one hand, in autumn, conduct our migrants from their breeding homes to, or very near to, their winter quarters in one uninterrupted, and for the most part, nocturnal flight; and on the other hand, in spring, convey them in the opposite direction from their winter quarters to their breeding haunts—the uninterrupted continuity of the flight being still more marked in this latter phase of the migratory phenomenon."

On page 53 he further remarks: "In the case of our small

Warblers, Thrushes and the like, this limit of visible elevation may perhaps not amount to much." Of course a Thrush, or any smaller bird, becomes invisible at only a very moderate height, but one may perhaps be excused a feeling of surprise to read on page 76 that—"Under normal conditions the migrations of most species proceed at a height of at *least* 20,000 feet," or, roughly speaking, a trifle less than four miles. When we recollect that the highest mountain peak of the Himalayas does not exceed 29,000 feet, we get some idea of what the elevation must be at which, according to the theories of the author, migration is performed by the more robust species.

Having learned so much respecting the character of normal migration, it becomes necessary to further inquire what is the author's idea of normal and abnormal weather, for if the state of the atmosphere governs the manner and height at which the migratory flight is performed, then the latter can only be described as normal or abnormal in a secondary sense, as it is the direct outcome of the former.

On page 76 we find the following:—"Birds naturally choose for their migrations those strata of the atmosphere which offer the most favourable conditions to their progress. It is, however, a fact of peculiar interest, that during both migration-periods of the year, all species, without exception, approach in largest numbers to the earth's surface when very light south-easterly winds, accompanied by clear warm weather, happen to prevail for any length of time in the lower regions of the atmosphere. If autumn brings a long spell of weather of this kind, we may not only reckon on the appearance of large numbers of all our common visitors during September and October, but may also look forward with certainty to the frequent occurrence of species very rare in Europe, and originating from the far East. . . . from all these facts it appears that the meteorological conditions discussed above are those best adapted to the migrations of birds, and that the latter betake themselves to strata of the atmosphere in which such conditions prevail" (page 77.) Herr Gätke's remarks have been previously quoted to the effect that visible migration is the abnormal phase of the movement, but as the height of the flight is governed by the prevailing weather—in the light of his theories

—it follows, therefore, that we are forced to the conclusion that the prevalence of warm weather with light south-easterly winds near the surface of the earth is also abnormal. And again, as he also does not recognise such a fact as retarded or deflected migration (page 75), then the constant prevalence of such conditions of the weather before described, at some height or other, becomes an absolute necessity to the performance of migration.

Let us just consider whether light south-east winds with warm weather at the periods of migration can be fairly considered abnormal. Herr Gätke himself has many remarks to show that at one period during his long experience such meteorological conditions were for many years the rule rather than the exception, and he also gives us tables showing that these conditions prevailed for long periods over immense tracts of land in Asia. Another important point, too, must not be overlooked. There is absolutely no evidence to prove that these same conditions do not prevail up to great heights in the atmosphere at the same time as they obtain near the surface of the earth. If such is the case, as seems very probable, one naturally wonders why do birds perform their migratory flights near the earth's surface, when there is nothing to prevent their accomplishing their flight in the—according to Herr Gätke—normal manner, or at the immense heights before stated? As this is not their custom, under these conditions it seems reasonable to infer that they really prefer to migrate at lower elevations. It will, perhaps, be readily admitted that migration in the earlier stages of its development was conducted at low elevations and in short stages, such as described by Herr Gätke on page 46. Taking into consideration this fact as well as the foregoing evidence, and also bearing in mind the wonderful records of visible migrations presented to our notice by the author, would it not be more reasonable to look upon the migration, which is said to take place at such vast heights, as the abnormal rather than the normal?

It is difficult to understand how Herr Gätke postulates a migration on a large scale at heights far beyond our vision. His notes on certain birds rising to great heights on setting out, refer to highly specialised species given to soaring at all times of the year. To the writer he seems to base his theory on the

negative evidence afforded by the absence of certain birds in particular years; direct proof is of course practically unattainable. There is also another point worth noting. Herr Gätke describes migration proper as being conducted at both periods of the year in one unbroken and for the most part nocturnal flight, the unbroken character being more pronounced in the spring than in the autumn. Why, therefore, do birds tarry at such an uninviting little spot as Heligoland, when all the conditions are favourable to the performance of this unbroken flight? It may be pointed out here, that while a migratory flight may be fairly called unbroken which does not call at the island, if reference to Heligoland alone is intended; still, for all that, there are many other places where rests may be taken, but of which we have no records. A reference to American statistics is all against this theory of an unbroken flight (*vide* "Migration in the Mississippi Valley," (Cooke and Merriam, 1888).

Having examined into Herr Gätke's theories as to the conditions most favourable to the performance of the so-called normal manner of migration, the question naturally arises, by what sense or by what means do birds, wishing to migrate, make themselves acquainted with the state of the atmosphere at the vast heights at which we are told they conduct their journeys? Supposing the winds at their winter quarters are, as the time for departure approaches, of an unfavourable character —are we to assume, therefore, that as the impulse to migrate becomes irresistible, that birds make voyages of discovery up to great heights in search of favourable strata of the air, or are they supposed to be possessed of some sense which will enable them to detect the presence of favourable air-currents at great heights without this faculty being rendered inoperative by the unfavourable conditions prevailing at the time near the earth? His further remarks seem to favour the latter theory, for on page 78 he writes:—"We can hardly admit that birds seek such strata at haphazard; we ought rather to assume that they are possessed of an inherent presentiment or sensitiveness to distant but approaching phases of the weather. We are supported in this view by the fact that many birds in confinement manifest much unrest, by fluttering and by the

frequent utterance of their call-notes on days which precede nights of strong migrations." It may, perhaps, be readily admitted that the power of foretelling some twenty-four hours ahead, approaching changes which will affect the weather locally is possessed by the great majority of birds, and we can easily understand how such a faculty has been acquired through the process of natural selection. But is there any evidence to show that this faculty is operative from the surface of the earth in a vertical as well as a horizontal direction? All changes in the weather, according to the author, becoming first evident in the higher regions of the air. The fluttering of a captive bird of a migratory species on days preceding strong movements, may point to nothing more than the periodically recurring impulse which must be inherent in all such species. If we attribute this restlessness, however, to a knowledge of a change in the atmosphere which will bring about an abnormal migration—abnormal both in strength and character—then we must assume that this sense, which enables the captive to perceive the coming change, is only operative at times corresponding to the usual periods of flight, otherwise we should expect a similar exhibition of restlessness at every coming change in the atmosphere. In the face of this contention it seems more reasonable to attribute this restlessness to inherited desire to migrate becoming active at these particular times. If we grant that birds have the power of discerning the state of the weather in the countries ahead of them, we can only wonder why so many come to grief in performing their migration prematurely. That this often happens there is abundant evidence to show. Mr. Seebohm's experience of this premature migration in the Valley of the Yenesay is a well-known instance. With regard to Herr Gätke's remark that the sensitiveness of birds to the first faint indications of an atmospheric change must be at least equal to that of a good barometer, this may, perhaps, be granted, as it is no uncommon thing to meet with human beings who are able to predict with constant accuracy the state of the weather for the coming twenty-four hours. This is accomplished with no other aid than their natural senses. However, Herr Gätke adds that—"we must not forget that in the elevated regions in which their migrations proceed, birds are brought under

the influence of the slightest signs of an approaching change of weather long before anything of the impending change is perceived on the earth's surface, where the earliest indications of it are probably not felt until about twenty-four hours later." He further remarks—"It can hardly be doubted that all changes of weather have their origin in the higher strata of the atmosphere" (page 78). If birds have twenty-four hours' notice of a storm before its approach is detected on the earth, through flying at great altitudes, it is difficult to imagine why, considering the high rate of speed at which they are supposed to migrate, that they do not put forth their powers and convey themselves to a place of safety without breaking their flight at all, or descending near to the surface of the earth. In the light of this enquiry it will be interesting to examine the behaviour of migrating birds on the approach of one of these disturbances of the atmosphere as described on pages 78-79.

After remarking on the familiar phenomena of the various layers of cloud travelling towards different points of the horizon, the author formulates the theory from a study of these movements, that the appearance of light fleecy clouds at great heights, traversing the heavens in an opposite direction to that of the wind at the surface of the earth, predicates a change of the latter to an opposite quarter. And as birds, according to his theories, travel at these great heights during the normal performance of their migratory flights, they would naturally become aware, or actually meet with the adverse wind or conditions, "long before anything of the impending change is perceived on the earth's surface." At a time, however, when the winds at the lowest elevations are light south-east, birds travel at only very moderate heights, it must be supposed because conditions above are unfavourable to so-called normal migration. It is difficult to see, therefore, how, whilst they are flying low, they can become acquainted with the first indications of the coming change, if they are only at that particular period exhibited at the great elevations before described; for it is not until the west or south-west wind gains the ascendancy at the surface of the earth —or in other words, that the coming change has taken place— we are told, that the migration passes into higher altitudes, its speed being at the same time strikingly accelerated.

On occasions like these the number of birds which alight during the morning hours, is at that time considerably diminished, and the few birds that do so, soon start afresh on their journey, so that by the time that the wind has completely changed to the west and rain has begun to fall, not another bird is to be seen. To the writer this all points to the fact that birds, on becoming aware of the approach of a storm from the quarter to which they are travelling, as a rule fly to meet it, and also hasten their speed in order to reach a desired goal before it breaks over them.

In formulating his various theories, Herr Gätke appears to be constantly under the impression that all birds which are passing his observatory have already flown long distances without a break before they come under notice.

If the relative position of Heligoland to the adjacent masses of land is studied, and the observations of other ornithologists are borne in mind, the opposite conclusion can hardly fail to be arrived at, the majority of birds having probably only executed a short flight before their arrival at the island. This must be especially the case during the autumnal migration. As Heligoland presents such limited accommodation for rest and food, they are compelled to fly further on, in the face of the approaching storm, to seek the necessary food and shelter elsewhere. It is difficult to imagine, however, if at the time of starting they were actually aware of the storm they would have to encounter on their journey, why they should set out at all.

In the face of these considerations it seems more reasonable to suppose that migrants flying towards a storm only become aware of its approach about the same time as an ordinary barometer at the surface of the earth would have indicated its vicinity. The particular instance, so graphically described on page 79, as occurring the third week of October, 1882, seems to bear out this contention. Birds which had been migrating at low elevations in large numbers for a fortnight previously, the weather having been favourable, on becoming aware of the approaching change, hurried forward at great speed to reach a place of shelter before it burst upon them. Whilst the storm raged no birds were seen at the island, but in the opinion of the author, migration was not interrupted but continued in its normal

manner at great heights above, the atmosphere in these elevated regions being supposed to have returned to a state of calm.

It seems hardly likely, however, that any birds would set out to cross a wide sea under such conditions, and the appearance of migratory flocks during a lull on 24th, when the wind had considerably abated, points more to the fact that these individuals had been merely awaiting a favourable opportunity to continue their journey at some locality near at hand. Some light is thrown on the theory that these migrating birds had only become aware of the weather they were to encounter from indications present at the earth's surface, from the fact that many of them were Hooded Crows, a species which only under most exceptional circumstances migrates at a height of more than a few feet above the surface of the land. They, in any case, would not have felt the first indications at a great altitude. The assertion, however, that the Hooded Crows had become aware of the approaching storm at a distance of 1,200 miles from the area in which signs of the disturbance were then becoming evident, *i.e.*, in the Hebrides, depends entirely on our acceptance of Herr Gätke's statements as to the rate at which this species migrates, and also as to the direction from which the flocks are derived. The position of their starting-point, *i.e.*, 600 east of Heligoland, being purely theoretical. Had they been coming from Scandinavia, as seems more probable than from due east, then there might have been at their point of departure local indications of the approaching change some time before they became apparent in Heligoland. So far from the first indications of changes in the weather becoming first perceptible at very great altitudes, where the air is very thin, it seems far more reasonable to suppose that near the surface of the earth where the influence of the large masses of land and water, coupled with the greater effect of the sun's rays on the denser atmosphere, is the region where all changes of the weather have their origin and become first apparent. At any rate the appearance of light fleecy clouds travelling at a great height in the opposite direction to the wind prevailing at the surface of the earth, followed by others, at a lower level and eventually culminating in rain, is hardly sufficient evidence that the converse is the case.

It must not be forgotten too, that normal migration, according to the author, is not only performed at a height of not less than four miles, but is also carried out at a great speed, and to use his own words—"in one unbroken and for the most part nocturnal flight." This supposed possession of a sense enabling birds to detect the state of the atmosphere at heights exceeding four miles, must, to be of really much use, greatly exceed the power of a barometer in order to enable them to ascertain the meteorological conditions they will encounter eight or nine hundred miles or more distant from their starting point, and that they are able to do this there is no evidence to prove.

It must often happen, however, that changes of the weather at the earth's surface do take place after such indications merely as coincidences, in the same manner as a mass migration supposed to be induced by a desire to escape difficulties in front, may in reality be pushed forward into dangers ahead by causes in the rear.

It must be by no means forgotten that all Herr Gätke's observations on the weather have been conducted in the very limited area in which he resides, and though there is no reason for doubting the accuracy of his statement that birds migrate nearest the surface of the earth during the prevalence of light south-east winds, the fact must be taken to apply only locally. A reference to the charts published in the daily papers referring to the winds of the previous twenty-four hours, will very commonly reveal the fact that the air-currents nearest the surface of the earth are traversing semi-circular or even still more eccentric paths. Thus a south-east wind at Heligoland may in the Baltic have been travelling from the north-east and the same current in the North Sea might be locally recorded as a south-west wind. Herr Gätke also draws attention to the fact that the greater or lesser quantity of moisture in the atmosphere has also an important influence on the amount of visible migration. The quantity of moisture in the air is generally determined by the direction from which the wind has been travelling, and also the comparative areas of sea or land over which it has passed; thus, in the British Isles, winds blowing from quarters between the points of north, north-west and due south, are, as a rule, heavily

charged with moisture, whilst, on the other hand, those from the north, north-east and east are, as a rule, very dry. Winds from the south-east, as regards the amount of rain which accompanies them, are very variable, but the local observations of the writer tend to establish the fact that a south-east wind of three or four days' duration culminates in a downfall.

In presenting evidence in favour of his theory that south-east winds are the most favourable conditions to the performance of migration, Herr Gätke has been at considerable pains in obtaining statistics that these winds prevailed over a vast tract of country lying to the east of Heligoland during certain years when the island was especially visited by a large number of birds which he regards as migrants from far eastern Asia. However interesting these tables are, their value is much diminished by the absence of negative data. How are his readers to know whether or not in other years, when the so-called visitors from the far east did not visit, or only visited the island in very small numbers, south-east winds did not prevail over the same tract of country for nearly the same period? Another point must be noted. Herr Gätke frequently refers to Richard's Pipit as a visitor from the countries bordering on the Amoor River, or the shores of the Sea of Ochotsk; he also refers to the Yellow-browed Warbler in somewhat similar language, these two species being supposed to be particularly affected by these south-east winds. Now it does not seem to have occurred to him that a south-east wind blowing in the districts named must have a very different nature from the same wind at Heligoland. In the first instance it will have passed over the Pacific, and so probably have become densely charged with vapour, like the south-west winds of our own islands; and, in the second place, before reaching his observatory it will have traversed large areas of land, and in the meantime have shed its moisture on the intervening countries in the form of rain.

To take the tables themselves. It will be found that on examination of the statistics presented, though the preponderance of winds during the first-named year, viz., 1847, blew from the quarters said to be favourable to migration, still in the ninety-one days under notice eighty-six observations of unfavourable

currents were recorded, thus illustrating that there was no real constancy in any one direction. It has already been pointed out that in Herr Gätke's opinion it is these winds which have the extraordinary effect of turning a small proportion of certain migrating species from their normal course in favour of a long land-journey to the west of Europe, from whence very few of them ever return.

As an illustration of the danger of drawing conclusions from the presence of a particular species of bird at the periods of migration, without its full geographical distribution being known, the following forms a striking case:—In this particular year, viz., 1847, to which reference has already been made, Herr Gätke records the fact of the unprecedented number of Mealy Redpolls which visited Heligoland. These he informs us were mixed to the extent of about one-third with individuals of what he terms the eastern form, *i.e.*, F. exilipes; further remarking that Redpolls are altogether of an extremely rare occurrence in Heligoland. The Mealy Redpoll, as is well known, is fairly common throughout northern and north-eastern Europe, and, moreover, is a very hardy species, and which ought to be considered perhaps more of a gipsy, than a regular migrant, and to the writer there is absolutely no evidence that these flocks came from the far east. With regard to F. exilipes the history of the geographical range of this species or form will—in the opinion of the writer—find its parallel in the cases of Anthus Richardi and P. superciliosus at some future date when their full extent is known.

Messrs. Pearson in their trip to Russian Lapland, found this Redpoll breeding pretty commonly near the village of Lutni, where they state it was the Redpoll of the district (*Ibis*, 1896). No doubt further research will reveal the fact that it occurs throughout northern Russia in comparative plenty. Thus it seems far more probable that the large flights of Redpolls at Heligoland in 1847 came from the north of Europe and not from the far east. In passing it may also be pointed out that the Northern Bullfinch is another species to which Herr Gätke also alludes as an eastern one, as though it were absolutely confined to the continent of Asia.

It will be opportune here to quote Mr. W. Eagle Clarke's remarks on the meteorological conditions affecting migration, as presented in his "Digest of the Observations on the Migration of Birds, 1880-1887." Mr. Clarke states at the outset that observations he has utilised have been constantly conducted and reported from fifty-four stations distributed over western Europe, between Haparanda and Bodö in the north, and Toulon, Biarritz and Corunna in the south, as well as all parts of Great Britain and Ireland. Mr. Clarke remarks:—"When studying bird migration in connection with meteorological conditions, it is essential that the weather peculiarities synchronous with the setting in of the migration, and prevailing in the particular area in which the movement had its origin, should be considered. This alone has any true bearing upon migration, not the weather prevailing upon the shores reached after an extended migratory flight. . . The weather influences are of two kinds. (I.) Ordinary weather influence. It is found that in both the spring and autumn migratory periods there are spells of genial weather without marked features, other than those favourable for migration. During these the movements of the various species are of an even-flowing and continuous nature. If the weather should prove slightly unsettled during such periods, it is a matter of indifference to the migrants; if more pronouncedly so, their movements are slightly quickened thereby. This may be termed normal migration under ordinary weather conditions.

The duration of such favourable spells, however, is sooner or later broken by the advent of a cyclonic period of a more or less severe type. This interferes, to a greater or lesser degree, with the progress of the migratory movements.

(II.) Extraordinary weather influences. These are exerted by the prevalence of particular weather conditions, which may act either (1) as barriers to the ordinary movements, or (2) in diametrically the opposite direction, as to incentives to great movements, or "rushes," as they have been termed.

The weather barriers to bird migration, are unfavourable conditions of a pronounced nature, which interrupt and make impossible, during their prevalence, the ordinary seasonal movements.

"The weather incentives to migration are widely different in their nature, and may take several forms. First, there may be favourable weather periods immediately following unfavourable periods. Secondly, they may be due to weather in certain respects unfavourable to the birds, such as a decided fall in temperature, which either compels birds to move, or acts as a warning that the time has arrived for their departure southwards. Such cold spells are characteristic of anti-cyclonic periods, when the weather is calm and highly favourable for a prolonged flight. Thirdly, and on the other hand, the advent in spring of a genial spell, especially if accompanied by a rise of temperature, is an incentive to a move to the northward for the summer haunts.

"The weather influences thus vary considerably; but temperature plays the most important part in the various seasonal movements, and is the main controlling factor in all extraordinary movements, other meteorological conditions being suitable. Each movement, however, has its peculiarity, and the conditions controlling it are often due to meteorological phenomena of a more or less complex nature, most of which, perhaps, admit of explanation."

Referring to the great autumnal movements of birds to our eastern shores, Mr. Eagle Clark remarks, p. 20—"It has been ascertained that *all* these great movements are due to the prevalence in north-western Europe of weather conditions favourable for migration. These conditions are the result of the following type of pressure distribution, namely, the presence of a large and well defined anti-cyclone over the Scandinavian Peninsula, with gentle gradients extending in a south-westerly direction over the North Sea. On the other hand, cyclonic conditions prevail to the westward of the British area, with a low pressure centre off the west coast of Ireland, or, though less frequently, over areas further south. Under these pressure conditions the weather is clear and cold, with light variable airs over Norway and Sweden, while in Britain the sky is overcast, and moderate and strong easterly winds are experienced, with fog not unfrequently prevailing at many east coast stations.

"The formation of these conditions in the autumn usually follows the passing away from Scandinavia—the area in which the movement has its origin—of a spell of a more or less pronounced cyclonic nature, during the prevalence of which the ordinary course of the migratory movements is either interrupted or rendered impossible. The effects of this sequence of meteorological conditions on bird migration are remarkable.

"During the cyclonic spell a weather barrier arrests the progress of, and dams back, as it were, the ordinary seasonal migratory stream. These periods, too, are not unfrequently characterised by weather of great ungeniality, and this, no doubt, gives the summer birds warning that the time for seeking the south has arrived. Upon the duration and severity of these preliminary conditions depends, to some extent, the magnitude of the migratory movement that follows.

"The formation of the anti-cyclone removes the cyclonic weather barrier, releases the flood, and provides conditions favourable for migration, adding also an incentive in the form of a decided fall in temperature."

Mr. Clarke then further illustrates how birds, starting under favourable meteorological conditions, on nearing Great Britain may fly into conditions the reverse of favourable, owing to the too close proximity or the depth of the western low-pressure centre. He further remarks on the exhausted condition in which many birds arrive under these circumstances, also stating that no doubt many sometimes perish during the journey. It will be seen that Mr. Clarke's conclusions are quite at variance with those of Herr Gätke, for in the light of the theories of the latter, migrating birds, on encountering the low-pressure system and its accompanying unfavourable winds, would not have their flight retarded or altogether prevented, but would merely elevate its path to regions above the disturbances and pass over the shores of Great Britain at heights beyond our cognizance. On the other hand, he confirms Herr Gätke's statement that the prevalence of easterly winds is favourable to the migratory flight, but not in the same sense the latter asserts is the case. It has been previously pointed out that Mr. Clarke's labours have resulted in the opinion that Heligoland and Britain draw their

migratory hosts from different sources. The question of the meteorological influences on an east-to-west autumnal movement, *viâ* the latter isle, therefore, need not be discussed here.

In view of the fact that Herr Gätke attributes the presence of many so-called far eastern species on Heligoland to the direct influence exerted by the prevalence for any length of time of light south-east winds, Mr. Eagle Clarke's remarks on winds in general will be interesting. On pp. 25 and 26 he remarks: "The importance attached to winds in connection with bird migration has hitherto been much over-estimated by popular writers, and their influence, such as it is, misunderstood.

"The conclusions to be drawn from a careful study of the subject are: (1) that the *direction* of the wind has no influence whatever *as an* incentive to migration; but that (2) its *force* is certainly an important factor, inasmuch as it may make migration an impossibility, arrest to a greater or lesser degree its progress, or even blow birds out of their course. We have the clearest proof, indeed, that birds do not migrate when the winds are exceptionally high, though they sometimes pass into high winds and gales *en route*, under the meteorological conditions which have already been described and explained. Ordinary winds—that is, winds not too strong—appear to be of small concern to the birds, for they are recorded as migrating with winds blowing from all quarters."

The extracts presently quoted in this pamphlet will illustrate the truth of the latter assertion.

Mr. Eagle Clarke further remarks: "It is, however, a fact that particular winds almost invariably prevail during the great autumnal movements, and these have hitherto been considered by some as the direct incentive to such migrations. Such is not the case, and it may be at once stated that these supposed favourable breezes are simply another direct result of the pressure distribution favourable to the movement. . . The winds prevailing and dependent upon the barometric conditions are easterly, chiefly south-easterly, breezes. There is really no reason why westerly (west, north-west, and south-west) winds, not too strong of course, should not, *other things being equal*, be in every way as suitable for migratory movements as those

varying between such divergent points as north-east to south." This, of course, does not affect the truth of Herr Gätke's statement that migration is performed in greatest strength, or is most apparent at the surface of the earth, during the prevalence of light south-easterly winds accompanied by fine warm weather, but it effectually disposes of his contention that these conditions form the incentive to small numbers of certain eastern species to forsake their customary routes of migration in favour of a flight from the far east to the far west.

Mr. Eagle Clarke further explains that strong westerly winds are unfavourable to migration simply because they are the result of types of pressure-distribution which are fatal to migration between North-western Europe and Britain, *i.e.*, the conditions prevalent in the former area, during their prevalence, would be so disturbed that birds would be prevented from setting out.

Herr Gätke, on p. 85, refers to the deterrent effect of fog on migration at Heligoland. Judging from his remarks, fog either prevents migrants from setting out at all, or induces them to perform their flights at great elevations. This is not always the case, however, for he mentions instances, both in his diaries and in the present work, of birds in large numbers being heard migrating above the fog.

Of course it is well-known that local fogs are far more frequent than fogs of great extent which envelop large tracts of land or wide areas of sea. Whilst the latter may prevent birds from starting on their flights, the former can only have a very unimportant influence on migration in general. It is easy to see, however, how a fog surrounding so small a spot as Heligoland, even if its extent was limited to the immediate neighbourhood of the island, might so hide the latter from the view of passing birds as to prevent them making their usual call.

With regard to the effect of fogs on the British coasts Mr. Eagle Clarke remarks, that during their prevalence more birds than usual approach the lanterns of lighthouses, and that many are killed on such occasions. These facts point to the correctness of the theory that migration, as a rule, is conducted at only moderate elevations.

Reverting again to the altitude of and general conditions affect-

ing migration, there are certain species of very regular appearance on Heligoland which Herr Gätke tells us always, or only on the smallest number of occasions, perform their migrations at very low elevations, viz., the Hooded Crow, Starling, and Skylark, and in the opinion of the writer, the Lapwing, Fieldfare, and Redwing might have been added to these. Are we to assume that these species are devoid of that special sense of approaching changes of the weather supposed to be possessed by the majority of species, or is it more perfected in them, so that they are always able to choose a favourable time for their journeys? The evidence presented by the author rather points to the former conclusion, for we read of Hooded Crows meeting with adverse winds and Skylarks being overtaken by thunderstorms.

If there is one fact calculated to strike the reader in perusing Herr Gätke's work more than another, it is the marvellous number of birds actually *seen or heard* passing his observatory. To the writer this fact alone is enough to make one pause before admitting that visible migration is the abnormal and invisible the normal. Those, however, who are also ready to agree with the author in his theory of a broad migration front corresponding to the breeding area, have to face in addition the incredible but necessary myriads of birds which must exist to enable the latter theory to be granted as even reasonably probable.

That certain species, such as Cranes and Hawks, fly at times to great heights, is undoubtedly a fact, and it may readily be seen that it is an advantage to the smallest birds to ascend to a good height before crossing wide seas. For it must often happen that they encounter sudden changes of weather which may materially retard their progress. Nansen in crossing Greenland experienced this at a height of over 8,000 feet—a gale which had been raging for two days suddenly blowing with only a pause of a few minutes from the opposite quarter. It is very evident that the further a bird has to fall, as its strength gradually fails, the greater chance it will have of eventually reaching the land, of course providing forward progression is not altogether impossible. But to the writer the effort put forward to attain a vertical height of four miles or more would, by the consumption of energy at the outset, more than counteract the benefit before mentioned.

It once fell to the lot of the author to witness an extensive migration of certain small species—Finches, Larks and Starlings, —on the Norfolk coast, during the prevalence of very strong southerly and south-westerly winds. At the point of observation numerous flocks of Finches, principally Fringilla cœlebs and chloris, were passing from north to south, closely following the eastern shores of the Wash. These birds were flying at a good speed and without any halt for rest, at a height of about thirty to forty feet. The same may be said of the Starlings and Skylarks. On one day, however, when the south-west wind was particularly strong, flocks of Finches might have been observed coming in from directly over the sea. These birds did not come headlong down from a great height; though they appeared when first viewed like small specks of dust, just as described by Herr Gätke. Now these latter flocks did not, on reaching the coast-line, alight for a rest, but hurried on at the same elevation and in the same direction as the first-named flocks, thus plainly showing that they had not reached their journey's end. It seems probable, therefore, that it is only when passing over wide areas of sea that small birds mount to any great height, and even then there is no evidence to show that they rise to such altitudes as Herr Gätke endeavours to prove, or that they will necessarily meet with conditions more favourable to their migrations in the latter regions.

It will be interesting to compare the observations of other ornithologists living in different localities on the winds most favourable to visible migration with those of Herr Gätke. The following extracts are taken from Mr. John Cordeaux's "Birds of the Humber District" (pub. 1872).

Writing on the Short-eared Owl he remarks (p. 13): "The winter of 1865-66 was characterised by large arrivals of these Owls, when after some heavy northerly gales during the last fortnight in October many appeared at various localities along the eastern coast."

Further on he quotes the following note by Mr. J. R. Griffith, from the *Zoologist*. The latter observer remarks (p. 27): "I write to inform you of the occurrence of the Blue-throated Warbler (P. suecica) off the coast of Norfolk. While crossing from Christiania to London by the ss. 'North Star,' we had

observed many birds performing their autumnal migration; the Wheatear, Titlark, and Ring Dotterel had been seen in mid-ocean, flying easily against a light S.W. breeze. The number of these migrants increased as on September 1st we approached the Norfolk coast, many of them, as the weather was thick, settling on the ship." Then follows a description of the Bluethroat. On p. 37 Mr. Cordeaux has a note to the effect that in 1869 the first flights of Goldcrests arrived at Spurn on the night of October 11th, wind N.W. to N. Again, on p. 70, writing on the migrations of the Cuckoo, he states that "much depends on the nature of the season; a cold backward spring with a prevalence of easterly winds always delays their appearance. A change in the direction of the wind about the second or third week in the month, from N. or E. to S. or S.W., is certain to bring them northward."

His notes on the arrival of the Woodcock are particularly interesting. On p. 123 he remarks: "With the prevailing winds off the land in October from S. to W., it is never a great Woodcock season on this coast, but strong winds blowing anywhere from the opposite quarters, from S.E. to N.W., and better, thick, foggy, or drizzly weather accompanying these winds, are invariably highly favourable to an abundant arrival of 'cocks' along the eastern seaboard. The stronger the wind and the wilder the weather from these quarters, the greater, as a rule, the number of birds that may be found. *It does not follow, however, that these winds are the most favourable for the passage of the Woodcock; I am inclined to think the reverse is the case*, and that we shall find that the most favourable circumstances for their crossing, as well as our other autumn visitors, *are clear weather and moderate winds from the W. or S.*, and that a long flight is best kept up, and easiest sustained, either against a head wind or one a 'few points free.' The fact that Woodcocks are always most numerous at the period of migration on this coast during the prevalence of strong north or easterly winds, shows that these soonest exhaust their powers of flight, causing them to drop directly they make land, instead of proceeding, as they doubtless would have done, with a fair head wind, directly forward to their winter quarters."

The above passage also throws some light on the height at

which Woodcocks travel, for, according to Mr. Cordeaux's observations, they do not seem to rise to a strata of the atmosphere out of the reach of the unfavourable winds before alluded to, but to battle against them until they reach the land. In the light of Herr Gätke's theories on the slight changes in the weather which will influence the current of migration they should adopt the former course.

On p. 123 Mr. Cordeaux has also a footnote to the effect that at the period of the autumnal migrations our various migratory species, both of shore and land birds, are invariably most abundant on this coast during or after the prevalence of strong N. or N.E. winds. Many observations on the varying character of the winds accompanying migration might be culled from the "Reports on the Migration of Birds." The following may be quoted (Sixth Report, 1884).

"East Coast of Scotland.—Long spell of E. winds in April and rushes, but a light S.W. wind on the 30th, changing from S. to E., brought a 'wonderful rush of land birds.' This seems to me [Mr. J. A. Harvie Brown] interesting, as proving the station to lie in the direct route of migration, rushes occurring both in the most favourable winds—S.E. or E. (*i.e.* for spring migration), and those supposed to be less favourable, and following winds, viz., S.W."

"A later schedule, April 30th to June 3rd, shows evidences of a decidedly late spring migration, for which it seems difficult to assign a cause. . . . It took place in second week of May, and with light S.W. and W. winds, mist, fog and rain; principally of warblers and insect-feeding species." *(Isle of May.)*

"*Inch Keith.*—This land-locked station returns a light schedule, of considerable interest, however, as carrying out what has been remarked by us in previous reports, that when birds do occur here on migration it is usually with S.W. and westerly winds, whether in spring or in autumn."

The following note refers to a strong migration at the Isle of May, from November 4th to 6th. The wind was apparently S.E. or S. at the commencement—though the report does not actually state the fact—afterwards changing to W. The editor remarks: "Mr. Agnew describes this as the largest rush of migrants this

season at the Isle of May, and it must have been very vast, close, and determined, when even on the 6th, with light W. wind, large numbers of Bramblings and Chaffinches still appeared." Other notes to the same effect might be readily quoted, but the returns from the east coast of England, which, as they include an area of latitude identical with the island of Heligoland, should provide the most interesting material for comparison. Thus we find :

Turdus viscivorus.—Redcar, October 4th. Flocks of Mistle Thrushes coming in ; wind N.W.

Turdus iliacus.—Between Farn Islands and Hasborough, L. V., at various stations from October 1st to November 15th ; rushes on October 21st to 24th ; wind S. and S.W. On the same dates as the latter, numbers passed Heligoland, but the direction of the wind there not stated.

Turdus pilaris. — The following Heligoland note occurs: December 1st, 24th, and 30th (S.W., still overcast). On the latter day very large numbers, and with a N.W. wind : windy and rain; an example of T. migratorius was reported as seen quite close.

Turdus merula.—Spring, at Northumberland stations, from March 14th to 20th many ; wind W. and S.W.

In a foot-note the Editor quotes from a letter received from Longstone Lighthouse as follows :—" November 10th.—All kinds of small birds coming all day. . . . wind southerly; hazy weather. . . . 11th.—Birds still coming ; all kinds, or rather the small kind. . . . 12th.—Great rush of Blackbirds, Ouzels, Redwings, Lapwings, Grey and Golden Plover, &c. . . . This is the greatest rush of the season, and lasted all day up to 10 p.m. Complete absence of Starlings. Wind all day from S. to S. by W., after midnight changing to N.W." It is curious to note that there was no corresponding rush across Heligoland during the same period.

On p. 44 follows a very interesting note on Cyanecula suecica (Arctic Bluethroat). Cley and Blakeney (as observed by Mr. F. D. Power) : September 8th, W.N.W., one : 11th, E. to N.N.E., one shot, showing red spot fairly well ; 12th, E. to N., eighty to one hundred, also many Redstarts. . . . 13th, E.N.E., about four dozen left on bank ; 15th, E., eight or ten ;

16th, S.E., and later, N.E., four or five. Spurn, September 15th, two seen, one shot; 18th, three shot and others seen. Isle of Thanet, September 13th, two seen. . . . Heligoland, August 31st, some young; September 1st and 3rd, pretty numerous; 9th and 19th, very many; 11th and 12th, very great numbers, and less to 18th, 19th and 20th. They were thus most numerous at the latter locality at the same time as the largest flock was observed in Norfolk. Commenting on this immigration of Bluethroats to the Norfolk coast Mr. J. H. Gurney remarks:—"It would seem that the Bluethroats came in just the sort of company they might have been expected in, viz., with Tree Pipits, Wheatears, Yellow Wagtails, and Greater Whitethroats, and this company probably arrived with a light wind from the north. On September 13th, the day before they were noticed, the wind was light N.; on the 12th it was light N.E., or E.N.E., and on the 11th it was N.N.E.; on the 17th the wind was N.E., and they probably left Blakeney, and migrating against it, got as far as Yarmouth and Lowestoft 'denes.' On the 18th it was S., and pursuing the coast southwards they most likely crossed the Channel. . . . The two birds shot by Mr. Power on the 22nd at Blakeney were I imagine, a later arrival, and if, as is most probable, they came on the previous day, it was with a west wind, *i.e.*, a contrary wind. On the same day a Bluethroat was shot on the coast of Northumberland, as I learn from Mr. T. H. Archer, and the day before one was identified, but not shot, at Tees mouth." Then follows an interesting foot-note in which Mr. Gurney quotes Mr. John Cordeaux, to the effect that "it may be laid down as an axiom that, with southerly or westerly winds, not amounting to gales, normal migration to our east coast in autumn is the rule (see 'Report on Migration,' 1881, p. 39). No wind at all suits small birds best. It seems, when bent on migration, they will make the passage with a light cross wind, but very rarely indeed with a wind which is due in their favour." The opinions of two such experienced observers as Mr. Cordeaux and Mr. J. H. Gurney will naturally be held in great respect, but it will be seen that they are in conflict with that of Herr Gätke, who states that on the prevalence of light E. winds, *i.e.*, winds due in the favour of birds, migration across Heligo-

land to our east coasts then takes place in greatest strength. In view of Herr Gätke's remarks on the direction of winds most favourable to visible migration, which he states are from E. or S.E., or some points approximating thereto, it will be interesting to note to what extent birds are seen to pass Heligoland when winds are blowing from so-called unfavourable quarters. In the seventh "Report on the Migration of Birds" for the year 1885, will be found a complete diary referring to the island, compiled by himself for that particular period.

The following entries will show that considerable migration takes place almost under all conditions of the atmosphere :—

"*February* 26*th.*—S.W., early fog; p.m. clear, fine. Corv. frugilegus ten thousands, Cornix few, Sturnus many, Merula few, Alauda passing on overhead. . . . Fr. chloris, cannabina, cœlebs many, particularly first. . . . Ant. pratensis and rupestris many. . . Ch. auratus, vanellus and hiaticula, Fr. alpina and Num. arquata all migrating in great numbers."

Then follows a curious commentary on Herr Gätke's statement as to the most favourable winds.

"*February* 27*th.*—S., S.S.E., forenoon fog; p.m. clear, fine. All the above, but less in number." One would naturally have expected greater numbers, owing to the favourable change of wind.

"*March* 5*th.*—N.W., light overcast. Corvus frugilegus and Sturnus, not many. . . . Al. arvensis very many. . . . Char. vanellus thousands, auratus hundreds. . . . Num. arquata and Tringa alpina many.

"*March* 9*th.*—N.N.W., windy, cold, now and then fine snow, and clear. Corv. cornix little flights. . . .

"*March* 15*th.*—N.N.W., windy, cold, overcast; in evening fog till 1.30 a.m. F. merula tolerable. . . . Sturnus flights. . . . Vanellus early, some flights. . . .

"*March* 16*th.*—W., violent, cold, overcast; in evening clear. Corv. cornix six to ten, Sturnus till nine in morning; flights of hundreds and thousands. Merula a few hundreds. . . . Al. arvensis many, Char. vanellus and auratus passing on overhead. . . . Tr. alpina early, great flights. From two o'clock till day-light at lighthouse. Sturnus vulgaris extraordinary

many. . . . Merula very many. Alauda, Ch. vanellus and auratus also very many; also ducks.

"*March* 27*th*.—S.S.W., violent, overcast, cold; in evening, ten o'clock, fog. Corv. cornix early, a few great flights. . . . Col. palumbus pretty many; Vanellus early, pretty many; Scolopax twenty to thirty been shot."

On the previous day the winds were light S.E., but unaccompanied by any remarkable migration, except in the case of Alauda alpestris, which passed in great flights.

"*March* 28*th*.—N.N.W., slight, early overcast; later clear, fine. Cor. cornix single flights, Sturnus some flights, Merula pretty many. . . . Al. alpestris some flights. Woodcocks—140 to 150 being shot.

"*March* 29*th*.—Northerly, light, clear, early hoar frost. Monedula, frugilegus pretty numerous. . . . Merula early, pretty many; Mot. alba several small flights; Ant. pratensis and rupestris pretty many; Scolopax, about twenty shot.

"*March* 30*th*.—E., S.S.E., slight, clear, fine; early, very sharp hoar frost; in evening E.N.E., cool. All the above, but in little numbers.

"*April* 3*rd*.—N.E., fresh, cold, clear. . . . Al. alpestris pretty many.

"*April* 4*th*.—N.E., slight, cool, clear; in evening E. by S., cloudy. . . . Al. alpestris pretty many; Scolopax, forty to fifty being shot. Then follows a day with S.E. winds.

"*April* 5*th*.—S.E., fresh, thick, cloudy; hasty clouds, low, loose; cold. — *Early not a bird; during day few* Starlings, Thrushes, Hedge-sparrows, and Shore Larks."

Then follow records of the 7th and 8th, with winds chiefly E., but accompanied by only moderate migration. On the following day (9th), wind E. by N., slight, weather good, clouds from S.S.E., the numbers of passing birds had materially increased. Amongst the arrivals were two Bluethroats.

"*April* 10*th*.—Easterly, light, thick, fine rain; in evening, W. and W. by N., light.—During the past night, from two o'clock, very many Turdus and Saxicola migrating. During the day extremely many of all the above species passing over the sea (*i.e.*, C. cornix, Monedula, Al. arvensis, alpestris, Mot. alba, An.

pratensis, &c., &c.). Fring. cœlebs, montifringilla, and cannabina in uncountable numbers the whole day.

"*April* 11*th*.—Easterly, light, dull, very fine drizzly rain.—Much migration on this date. Early in morning Peewits, Plover and hiaticula extraordinarily numerous."

Then follows the interesting entry on the 12th, with a light S.E. wind, dull and overcast — conditions very favourable to strong migration—"altogether, little migration."

On the 13th wind N. by E., slight, clear; passing birds were fairly numerous.

On the 15th, 16th, 17th and 18th, with winds S.E., almost calm; E. early, slight; E. and N.E. very fresh, clear, wind cool; E. by N., fresh, clear, a little warmer; on the above respective dates, migration is described as "very little, or extremely little."

On the 19th, however, wind "E. by S., S.S.E. slight, quite clear, warm."—There was an extraordinarily numerous migration of Hooded Crows, accompanied by other species in fair numbers.

On *April* 20*th*, with S.W. wind, clear, and W. and N.W. freshening up; in evening, light. There appears to have also been considerable movement going on, as the following entry for 21st will illustrate:—"W.N.W. and N.W. During past night extensive migration of all Longshanks." It is worthy of note that this took place under conditions said to be least favourable to the performance of visible migration.

Turning now to the autumn movement we find the following interesting entries:—

"*September* 9*th*.—S.W., windy, rain, low clouds; W., high clouds in evening; N.W., violent squalls.—Mus. luctuosa, Sy. phœnicurus and trochilus, pretty many, in spite of the south-west wind and rain. In night, stormy—thunder, lightning, rain and hail.

"*September* 10*th*.—W. by N. and N.W., stormy, rain squalls; in evening light.—luctuosa, phœnicurus, trochilus, pretty many in garden under shelter of shrubs.

"*September* 18*th*.—E. by N., moderate, overcast; in evening, N., fine, cold.—During the past night much migration" (wind on

17th, p.m., E.N.E.). Then follows a list of species, with remarks on their abundance, the final comment being, "Altogether, very strong migration."

September 19th.—A fairly strong migration occurred on this date also, with winds from W. to S.W.

September 25th.—On this date, with westerly winds, light, heavy cumuli, showers of rain with hail; in evening, light northerly. Several species were passing in considerable numbers, others also fairly plentiful. Herr Gätke makes the following significant remark:—"It is striking that with such monstrous heavy cumuli that have the appearance of storm clouds, so much migration takes place. There must be better weather at hand." However, this prophecy was not realised at once, for the 26th dawned "draught of air southerly, still so heavy, threatening cumuli at W. and N., but in spite thereof much migration." The movement was, however, increased in strength on a change of wind to "S.E., light, clear."

September 28th.—There was a further change in the wind to to "E.N.E., slight, light clouds, sunny," accompanied by much migration.

On *September 29th* a storm was notified from America to occur between 28th and 30th. If birds are able to foretell a coming change of this nature, we should have naturally expected them to have hastened their migration in order to escape the storm. However, there was very little movement on this date, though the winds were from the S. by E. light; later fresh, S.E. clouds; p.m., wind S.W.

On *September 30th*, with winds, "early, light N.N.W., clear; p.m. S. by W., thick, windy"—almost nothing at all.

Broken weather prevailed from October 1st to 6th, accompanied by very little migration, except a great flight of Snow Buntings on 3rd (wind S.W., thick, very stormy) and a few Parus major and cœruleus.

On the 7th the winds were N. to N.N.W., "better, clear; later, violent with rain squalls." There was an extensive migration of Hooded Crows and Starlings on this date, accompanied by other species in smaller numbers. Many Larus minutus, too, were observed at sea off the island.

On the 11th, with winds E.S.E., moderate; a.m., rain; p.m., clear; in evening, E.N.E., light, clear.—There was a large migration of several species. This was continued in lessened volume on the following day, with winds changing from N.N.E. to S.W., with rain showers.

October 15th appears to have been a very changeable day, the weather being described as "S.E., slight, clear, middle high clouds from W. by S.; noon, light, cloudy, wind E. by N., clouds from S. In evening, E. by N., violent, clouds from S. by E. In night, E., very violent, thick clouds from S.E. This erratic weather was accompanied by very strong migration of several species, and the author appends the following note:—"According to the weather in the morning, there ought to have been considerable migration—Thrushes and Woodcocks—but prominent westerly currents in higher regions acted adverse." It is difficult to understand, however, why these species should not have taken advantage of the "most favourable conditions" which prevailed at the time in the strata of the atmosphere nearest the earth's surface, for in the night of the 16th, during the prevalence of the violent weather before described, there occurred an "extraordinary strong migration of Larks, Thrushes, Starlings, *Numenius* and *Charadrius*."

On the 17th the winds and weather are described as northerly, light, quite thick with rain, low loose clouds slowly from N.W. and N., after midnight, dead calm.—"During the early hours until 9 o'clock extremely large flights of Thrushes flying about high, just as if bad weather was approaching." However, the predicted storm did not take place, for the following days appear to have been pretty calm and at times even sunny.

It is difficult to account for the behaviour of these Thrushes on Herr Gätke's theories as to the height at which migration is performed. Here we have unfavourable conditions to visible migration prevailing near the earth, *i.e.*, northerly winds quite thick, with rain and low loose clouds slowly from N.W. and N., and yet these Thrushes did not seek favourable conditions in the upper strata of the air, but fly about the neighbourhood of Heligoland instead of continuing their journey in the normal manner, at a height of 20,000 feet or more.

The above extracts will sufficiently illustrate the fact that while Herr Gätke's statement may be correct, that birds when on their journeys approach nearest to the earth when winds from the E., S.E., or E. prevail, it by no means follows that extensive migration is not to be witnessed under entirely different conditions, *i.e.*, at times when the winds prevail from quarters described as least favourable. It will also be gathered that winds from E., S.E., or S., are not of necessity accompanied by movements of birds, as one might imagine from the theories of the author, such winds in whose opinion form the incentive to exceptional migration from the far east.

Herr Gätke makes some interesting remarks in connection with the special organisation of birds; which becomes a necessity—if his theories as to the vast heights at which their migrations are performed, are accepted as correct—in order to enable them to sustain the cold they would naturally encounter, and to overcome the difficulty of respiration, owing to the thinness of the air.

He remarks (p. 47): "Birds, therefore, must be organised in such a manner as, on the one hand to be uninfluenced by so considerable a diminution of air-pressure as one meets with at heights from 25,000 to 30,000 feet; and on the other hand, they must be able to exist on the considerably reduced supply of oxygen obtainable in strata of such rare density." The means by which these difficulties are overcome are, in his opinion, the possession of a system of air-sacs, which communicate with the lungs. Setting aside for the moment the fact that, with the exception of certain highly specialised birds, which are at nearly all times of the year, given to soaring about at great heights, and that it still remains to be proved that the smaller species really attain such great altitudes during migration; it will be interesting to learn in what manner these air-sacs can be of such assistance to birds in performing their annual flights. In connection with this point, Herr Gätke remarks (p. 47): "Probably owing to the possession of these air-sacs, the flight of birds in the higher strata of the air is so much facilitated that they are enabled to apply the muscular power of their instruments of flight almost exclusively to the execution of their forward movements. This results partly from the fact that by the filling of the air-sacs the volume

of the bird is enlarged, and its specific weight considerably diminished, but also from the air taken in at any particular height being warmed by the heat of the body, and considerably rarefied in consequence, so that the contents of the air-sacs are always considerably lighter than the air which occupies surrounding space." To the writer several fallacies appear in the foregoing arguments. In the first place, any increase in the volume of the bird must also mean increased resistance to its passage through the air, and again, admitting that it is possible for a bird—though it is very difficult to conceive how it can be accomplished—to so regulate the action of its wings that nearly all the effort is expended in furthering its forward movement, it seems that this gain would also be counteracted by the loss of wing-power, owing to the lessened momentum obtainable by the wings from the surrounding rarified air. This is important when it is remembered that in Herr Gätke's opinion a speed of anything from 100 up to 200 miles an hour is maintained by nearly all species of birds throughout a flight of many hundred miles.

Herr Gätke appears to hold the opinion, when he speaks of the air in the air-sacs always being warmer than the surrounding atmosphere, that their contents can be retained without change for some considerable time. To take in a stock of cold air and then to warm it by contact with the body means also to expand it, and unless a constant change is going on it appears to the writer that the retention of a supply of expanded air for any length of time, without changing its identity, would be an absolute inconvenience to a bird. Herr Gätke also appears to hold the view that this warm air in the air-sacs means increased buoyancy to a bird. But according to Dr. Drosier, practical experiment has proved that in a pigeon weighing ten ounces, the gain in this respect would only amount to the fraction of a grain. In the opinion of the latter gentleman the air-sacs are a necessary part f the respiratory apparatus of birds. He makes the further statement that they are present in all species of birds, even such as do not fly. However, it is only fair to add that Herr Gätke gives only partial adherence to the theories he has advanced, for he remarks (p. 48): " More exact calculations based on physical laws, have undoubtedly compelled us to recognise that this warm

change of air in the air-sacs of birds is unable to facilitate their flight to any considerable extent. Nevertheless, long continued observations in Nature have convinced me that birds must be endowed with a certain capacity for soaring or floating in the air which is independent of the use of their external instruments of flight." Unfortunately he is unable to throw any light beyond the above suggestions, as to the nature of these aids to flight. That he, however, in the main attributes this capacity to the possession of the air-sacs will be gathered from his further remarks on p. 72. In the interesting account of his observations on the soaring upwards of a Buzzard and the appearance of Sparrow Hawks as they descended to the island, some light is thrown on another point, viz., the limit at which certain species of birds might be migrating without our being able to see them. Thus we find the before-mentioned Buzzard disappeared from view at a height of at least 12,000 feet, and a Sparrow Hawk appeared as a speck at 10,000 feet. Now bearing in mind that these elevations amount to about half the estimated height at which so-called normal migration is performed by the vast majority of species, it will not be unprofitable to calculate at what heights other kinds of birds would become lost to our view. We may fairly reckon the larger of the European Turdinæ at less than half the size of a Buzzard. Thus they should disappear at a height of 6,000 feet or less. The smaller species would equal half the size of a Sparrow Hawk. We should, therefore, lose them at 5,000 feet or so. Chaffinches, Pipits, Wagtails, Fly-catchers, and the larger Warblers are about half the size of a Song Thrush. They would become invisible at 3,000 feet. Whilst the delicate Phylloscopi and Gold-crests would be disappearing from view at a height of only 1,500 feet or less. It will be gathered, however, from Herr Gätke's remarks on p. 56 that it is not the largest species which migrate at the greatest elevations. For he includes "species allied to the Snipes, such as Curlews, Godwits, Plovers and their relations, as coming next in respect to the height of their migration flight in order to those already enumerated," *i.e.*, Song Thrushes, Red-breasts, Hedge Sparrows, and Golden-crested Wrens.

It will be readily admitted that an exceptionally keen sight

would be necessary in order to distinguish a Willow Warbler at 500 yards distance. Why Herr Gätke should have placed so high an estimate on the altitude of the migration path in the case of smaller species, without more direct evidence, it is difficult to imagine. All he tells us on this point is " in the case of the vast majority of migrants, both on arrival and departure, the vertical elevation at which they appear and disappear invariably represents the limit to which human vision is able to penetrate." When we read, however, (p. 76) " that the migrations of most species proceed at a height of at least 20,000 feet " under the so-called normal conditions, we see what a very wide margin there is between the latter estimate and the elevation at which all but the largest species would disappear from our view.

It may be further noted that this power possessed by birds of floating about or soaring upwards, which is said to be independent of the wings, in the opinion of Herr Gätke, finds its antithesis in the means by which certain aquatic birds are enabled to swim with the body completely immersed. To the writer it appears, that in comparing the two performances he quite overlooks the fact of the great difference in the density of the surrounding mediums. Whilst the inflation of the air-sacs in flying may make a very trifling difference to the buoyancy of a bird, their deflation in the vastly denser medium of the water, in conjunction with minor actions, may fully explain the means by which the latter act is accomplished. In needs very little reflection, to at once see that to deflate the lungs and the air-sacs, and at the same time expel the warm air, by compressing the outer coating of feathers, from the downy covering of an aquatic bird, means greatly lessened buoyancy. As an illustration of this, no better example could be found than that of shot birds, whose respiration in the meantime having ceased, and the latent heat of the body rapidly being lost, a few minutes after death lose all their buoyancy and merely float on the surface of the water like any other light object. Birds are generally supposed to have descended from some half-reptilian progenitor of aquatic habits, and the opinion may perhaps be hazarded that the air-sacs may, to some extent, be a survival of organs which found their greatest use in remote ages.

In commenting on the possibility of migration being retarded

or deflected, Herr Gätke refers to the practical utility of keeping records of the arrival and departure of birds in particular localities, which he thinks are of very insignificant value. The following remarks are curious but interesting. After noting the impossibility of effectually watching a district of four miles in diameter, he writes : — "The case of Heligoland is of course different, for here we may say without hesitation that literally not a single bird escapes observation." It will not be forgotten that in another place he has expressed the contrary opinion, that the number of rarities captured on the island is certainly exceeded by those which have not been detected. He further adds— "Notwithstanding, the results of notes of this nature can never amount to anything more than a list of such disturbances and interruptions of the main migration movement at the particular place of observation. . . From this, however, we are not able to form more than an approximate conclusion as to the actual duration of the migration, since we can never determine whether the first observed individuals of a species are in reality the inaugurators of the migration at that particular time, or whether they may not have been preceded weeks before by a vanguard travelling, according to the normal manner of the migration flight, at great and impenetrable heights above." Then follows the following significant statement—"On the other hand, it would appear to be extremely unsafe to base on observations of this nature, the line of arrival or the migration front of a species, or to draw conclusions from them as to the velocity of the migration flight. . . For in the first place, it cannot be determined whether one is dealing with individuals whose spring migration is proceeding in a northerly direction, and not with such as are pursuing an easterly course; and, further, one cannot establish with any degree of certainty, whether the first observed individuals of a species are actually the breeding birds belonging to the particular district of observation or not."

The truth of Herr Gätke's contentions is self-evident, though there are localities to which, in studying the migrations of particular species, they would not apply. As an instance, the colony of Pied Flycatchers in the Lake District of England may be pointed out. It certainly would not be very difficult to trace the

migrations of this clan of birds during their progress through England, or to detect the first arrivals. However, as a general rule the force of Herr Gätke's arguments may be readily admitted. But if they are applicable to nearly all other districts, they should certainly still more forcibly refer to Heligolander, for hardly a single land-bird migrates there to breed. All of the vast hosts passing are migrants pure and simple, and whether they call or not,—"Time gone by, birds gone by," as the Heligolanders say, is of no consequence. The full significance of Herr Gätke's remarks will be realised, however, when we remember that it is on data of this nature that he bases all his speculations on the velocity of the migration flight, the breadth of its front, and the identity of certain flocks of particular species which pass his island, with colonies of breeding birds in the north, or wintering residents in the south. As striking instances of this, the cases of the Northern Bluethroat and Hooded Crow may be pointed out.

Herr Gätke closes his long and interesting chapter on "Meteorological Conditions" with a lament on the smaller number of birds now observed at his observatory than was formerly the case. However, when we read of "tens of thousands of Rooks," "thousands of Lapwings," "extraordinary many Redbreasts," "astonishing numbers of Wheatears and Chaffinches," "Bramblings and Linnets passing in uncountable numbers the whole day," followed by "uncountable numbers" of Lapwings, "extraordinary many" Snipes and Ringed Plovers, and Hooded Crows, and so on *ad libitum*, in describing the spring migration of 1885; not to speak of great flights of Snow Buntings, Starlings, and Skylarks, with "Hooded Crows in hundreds of thousands," and Chaffinches in "thousands upon thousands," followed by "extraordinary many" Song Thrushes, and Ring Ousels, in the autumn—one cannot but feel that Heligoland is still the most highly favoured spot on the earth for the study of the wonderful phenomena of bird-migration.

VELOCITY OF THE MIGRATION FLIGHT.

HERR GATKE'S remarks in previous chapters on the uninterrupted character and great elevation of the so-called normal migratory flight of birds will have prepared his readers for high estimates as to the speed at which their journeys are accomplished. These high estimates, indeed, are quite a necessary sequence: for he also informs us that these unbroken flights are performed by birds with their stomachs entirely devoid of food. It is doubtful, though—however much one might be inclined to agree with the former theories—if anything he has previously written will have prepared his readers for the astonishing results as detailed in the following paragraphs.

Exception will be taken by many to his opening words on p. 63, where he remarks: "Many birds are able to follow the different pursuits of their life only by daylight, and become the most helpless of creatures as soon as darkness has set in. With the advent of the migratory period, however, their whole nature is changed to such a degree that after sunset they will soar to heights hitherto unknown to them, and on pitch dark nights are able to fly towards the goal of their wanderings with unfailing certainty. Similarly, the speed at which their ordinary daily locomotions in the air are performed has not even an approximate relation to the wonderful velocity of flight attained by them during their migration."

It will be gathered from the above statements that in Herr Gätke's opinion, the whole nature of a bird, including its powers of flight and vision, become entirely changed, or at any rate greatly augmented, during the periods of migration. In the light of this contention his allusion to the marvellous speed of indi-

viduals passing across the island to the oyster beds, four miles away, which he estimates at 200 miles an hour is curious. For these latter flights, it will be gathered, are merely undertaken in the daily search for food, and are not portions of a migratory journey. It is a pity that he does not think well to bring forward evidence on behalf of the assertion that birds become the most helpless of creatures as soon as darkness has set in, for observations all point to the contrary being the case. It need perhaps hardly be pointed out that many groups and species of birds become very active in seeking their food at dusk. The Ducks, Herons, Crakes, Rails, Bitterns, Plovers, Nightjars, and others amongst the larger species may be pointed to as instances, and, amongst the smaller are the Common Swift, various Warblers, such as Sedge and Reed Warblers, Nightingale, and also the Skylark. The latter named, however, are not active in search of food after sunset, but are ready at all suitable times during the breeding season to break into song, and, however dark the night, on being disturbed are able quickly and without difficulty to fly to a neighbouring haunt, where they are as vociferous as before.

As an instance of the keenness of sight possessed by Ducks, the writer has witnessed on several occasions, when a flight has, after sunset, visited a small sheet of water, partially frozen over with very thin ice hardly to be distinguished from the open water, that they pitched directly into the latter without the least hesitation, the open place, moreover, not being situated in the centre of the pond.

At the periods of migration, especially in the spring, there is no such thing as really a dark night, and even in the winter, when migration for the most part has ceased, pitch-dark nights are very exceptional, and in the experience of the writer, who does not claim any special gift of sight, it is rarely that the outlines of hills and woods cannot be distinguished at considerable distances. Coast lines, rivers and sheets of water, of course, will be still more readily discerned. It may be pointed out here that on the approach of cold weather, after a protracted mild spell during the winter, and long after the periods of migration are over, certain species make what may be termed supplementary migrations. These are frequently witnessed at Heligoland,

as elsewhere. Now it follows if these supposed augmentations of sight and endurance were peculiar to the ordinary migratory periods, that these supplementary movements would have to be made without their aid. They are not, however, observed to be conducted in any different manner to the seasonal flights. During the prevalence of fogs, conditions are necessarily quite unfavourable to any ordinary vision. Whilst it may be denied that the powers of sight possessed by birds during the periods of migration are augmented beyond ordinary times, it may be readily granted that the speed of flight they put forth may be considerably greater than that during the ordinary courses of their lives. But that at the latter period this speed is not always at their command, or, at any rate, is not increased by any special change in their organisation at the former time, must, in the face of the clearest evidence, be accepted as a fact. When a Plover or other species, capable of very rapid flight, is attacked by a Falcon it naturally exerts itself to the utmost to escape, and a wonderful increase in the speed of its flight is apparent; but as the Falcon still gains upon its prey, the latter has recourse to twisting and turning, simply because the limit of its speed has been reached, and is, in many cases, of no avail. Under the influence of fear it is natural that a bird will exert itself to the very utmost, and may attain to a marvellous velocity of flight. It may also be granted that at the periods of migration similar efforts may be made, but nothing that has yet been witnessed in an encounter between a Falcon and its prey can be said to approach to the tremendous velocities attributed to certain small species during their annual flights, according to the theories of Herr Gätke.

In commenting on the evidence furnished by the speed attained by domestic Pigeons, as illustrative of the powers known to be possessed by birds, Herr Gätke has, to the writer, fallen into a very simple error. Accepting the statement that 100 geographical miles an hour was accomplished by a Carrier-Pigeon from Ghent to Rouen as accurate, he remarks, in comparing the possible powers of the progenitor of the latter, *i.e.*, the wild Rock-Dove:—"It cannot be doubted that the flight capacity of the domestic form must have fallen far short of that of its primitive wild ancestor." This, he thinks, must be the case

owing to its having been in a domestic state for so many generations. He quite overlooks the fact, however, that in this particular strain the efforts of breeders have been directed towards one goal, *i.e.*, obtaining the fastest possible flyers. To accomplish this, for many generations artificial selection has been unceasingly at work, breeders mating only their best birds. It seems, therefore, more probable that, as in the case of the wild horse and English race-horse, the domestic Carrier-Pigeon can beat its wild progenitor, the Rock-Dove, in regard to the speed of its flight. Von Middendorf's calculations on the speed of migrants, to which Her Gätke objects, may be taken as fairly accurate in spite of the remarks of the latter. But they refer to another feature of the phenomena—*i.e.*, what may be described as the rate at which the breeding grounds are re-colonised every spring. His estimates will be found to be confirmed by the researches of American ornithologists (*vide* "Bird Migration in the Mississippi Valley," Cooke).

The Hooded Crow has been singled out by Herr Gätke as a species performing its migratory flights at a very high rate of speed. This is the more astonishing, as the heavy, plodding character of its flight is well known. Even Herr Gätke himself alludes to it as an "apparently sluggish flyer." It is surprising, therefore, to learn that his estimate of the speed attained by this species is no less than one hundred and eight geographical miles an hour. It will therefore be very interesting to learn how he has arrived at such a result.

On p. 67 he writes:—"This bird, which without question, must be classed among the less expert flyers, travels in autumn in innumerable droves across Heligoland and past both sides of the island. The first flocks arrive about eight in the morning, and are succeeded in undiminished numbers by flock upon flock until two o'clock in the afternoon, all travelling without interrupting their flight, in a westerly direction. According to the reports of my esteemed friend, John Cordeaux—with whose observations, conducted on the opposite east coast of England, I am in the habit of regularly comparing my own—the first flights arrive at that coast about eleven in the morning, and the last at about five in the afternoon; the latter being followed sometimes by

solitary stragglers. It has been repeatedly shown, and cannot any longer be subject to the least doubt, that the flights of these birds, which on this island appear far off on the eastern, and disappear on the western, horizon, are the same as those which arrive on the English coast from an eastern direction. Accordingly, these sluggish flyers pass over the three hundred and twenty miles of German Ocean in three hours, which gives a velocity of nearly one hundred and eight geographical miles per hour. This instance of migration speed is the more surprising, inasmuch as it is displayed in the case of a bird which one might almost call clumsy, and which certainly gives no evidence of corporeal dexterity."

The identity of the Hooded Crows passing Heligoland at eight in the morning, with the flocks reaching Lincolnshire at eleven, may be proved to the satisfaction of Herr Gätke. But to the writer it seems rash in the extreme to formulate a theory of so great a velocity of flight on such slender evidence. Even if we admit, though few will be inclined to do so, that the Hooded Crows passing Heligoland, or at any rate a small portion of them, eventually reach Lincolnshire, what evidence is there to show that the journey is accomplished by the most direct route, or in an unbroken flight? If, as does not seem unlikely, the first flocks which are observed to pass the island about eight in the morning are, as Herr Gätke points out, derived from the shores of Schleswig Holstein, from whence they have started some half an hour previously, then those which follow them until two in the afternoon—assuming that they in turn have started from some other locality about the same time as the first—will have already travelled, estimating the rate of their speed at the same rate, viz., one hundred and eight miles an hour; some six hundred and fifty miles. Now the first flights are not supposed to go much further than the east coast of England after passing Heligoland, or, say, some four hundred miles in all; whilst the last flights, in order to reach the same locality, will have travelled nearly one thousand. Does it not, therefore, seem more probable that the first flights which reach Lincolnshire about eleven o'clock in the morning, are derived from some locality in Western Europe, where they have rested

the night, before crossing the North Sea? The evidence which may be gathered from Mr. Eagle Clarke's digest of the observations collected from the lighthouses and lightships by the Committee on Migration, altogether favours this view.

We are not told that this speed of 108 miles an hour is attained under any special conditions as regards strength and direction of the wind, so we may fairly assume that the feat is accomplished during the prevalence of ordinary weather. In Herr Gätke's opinion the Hooded Crow is more indifferent than the majority of species in this respect. It naturally happens, however, that sometimes winds are encountered which, while they do not arrest their flight, still modify the manner of its performance in a peculiar way. On p. 27 we read—"During the autumn migration it frequently happens that when out at sea they are carried into air currents stronger than is suitable to their line of flight, a violent south-east wind being especially unfavourable to their normal progress. To escape the disagreeable experience of having this wind *blowing through their plumage obliquely from behind*, they turn their body southwards, and appear to be flying in this direction." This is, however, only apparently the case, as we are told that—"their flight is continued in as exact a westerly course and *with the same speed* as though the birds were moving under favourable conditions straight forwards," *i.e.*, a speed of 108 miles an hour.

The italicised portions of the above extract will shed considerable light upon the actual rate at which these Hooded Crows are travelling. It will be granted that a gale blowing with a force equal to fifty or sixty miles an hour will fairly cover the widest estimate of the force of the before-mentioned "violent south-east wind." But it is difficult to see how a wind travelling at this rate could blow through the feathers of a bird flying with a velocity equal to 108 miles an hour. A cyclist could have given Herr Gätke a hint here, and at the same time have drawn a more accurate estimate of the speed of these Crows. A rider travelling at the rate of sixteen miles an hour with a twelve-mile breeze behind him is quite unconscious of the latter were it not for the movements of surrounding vegetation. Indeed he will, even under these favourable conditions, be aware of a slight

resistance to his progress through the air, due to his own speed being greater than that of the breeze at his back. It hence follows that if these Crows turn their bodies to the south to escape the disagreeable experience of the wind blowing obliquely through their plumage from behind, that they must be travelling at a lower rate of speed than the latter to produce this effect.

After reading for the first time and reflecting upon these high estimates of the velocity attained by birds, as put forward by Herr Gätke, the writer thought it would not be uninteresting to time the number of wing-beats per minute performed by the present species during its daily flight, under ordinary conditions. Repeated observations gave a result of from 190 to 200. If we take the latter number as the basis of a simple calculation, we shall get as a further result 12,000 beats accomplished in an hour, during which period, in the light of Herr Gätke's estimate, 108 geographical miles should be covered—or at the rate of sixteen yards for each wing-stroke. Now the latter himself has classed the Hooded Crow amongst the less expert flyers. But a speed covering a distance of sixteen yards for each beat of the wings, or forty-eight yards per second—which, as has already been pointed out, is necessary to accomplish a flight of 108 miles an hour—would have the appearance of a very swift gliding motion. The latter is certainly not the character of the flight of the Hooded Crow, nor could such a flight be classed as other than expert.

Turning now from a robust bird like the Hooded Crow, to a dainty species of less than one-eighth its bulk, and to which Herr Gätke attributes the power of attaining a still higher and more incredible velocity of flight during its annual journeys, *i.e.*, the Northern Bluethroat. This is said to reach the astonishing speed of 180 miles an hour, in the case of the flocks passing Heligoland, and a still greater velocity in other instances. There is no other species to which Herr Gätke makes more frequent reference throughout his work than to this charming bird. It will, therefore, be interesting to here sum up the full extent of the performances it has to undertake in order to accurately fulfil all his speculations.

The more the latter are studied, the more involved in

difficulties they become. It will be necessary to recapitulate a little in examining the feats this poor bird is required to accomplish. On p. 37 the Northern Bluethroat is cited as a species performing its migrations from its breeding grounds in the north to its winter quarters in the south, in a rigidly-adhered-to, north-to-south line of flight, and in a broad column whose front corresponds to the longitudinal area of the former district. We are also told that Heligoland forms the most western limit of this migration front, and that the Bluethroat only in the rarest instances deviates from the aforesaid direction of flight. In spring the migration is conducted in a similar manner, but the direction of the flight is of course reversed. At this period of the year, if the weather be fine and warm, the bird is an abundant visitor to Heligoland. May 26th, 1880, is a date pointed out when this was especially the case. On this occasion—"all the gardens of the island teemed with them to such an extent that their numbers in the nearest gardens were adjudged above five hundred." This gives a good idea of the numbers of Bluethroats migrating by this particular fly-line. It is further stated (p. 265) that during its spring passage from *Central* and Northern Africa to the *north of Scandinavia*, in the absence of cold and dry northerly winds at the end of May and April, it appears on Heligoland as a daily visitor, and if, in addition, the weather be fine and warm with a light south-east wind, it frequently occurs on days of this kind in such large numbers that as many as from thirty to fifty males have been obtained. The migration thus lasts one month.

We also read that the Northern Bluethroat travels only during the night, setting out at dusk and ending its journey at daybreak, or immediately after sunrise. Hence, *being unobserved in intermediate localities*, it accomplishes a flight of more than 1,600 geographical miles from *Egypt* to Heligoland in the course of a spring night of scarcely nine hours, giving the almost miraculous velocity of 180 geographical miles per hour. The further fact that this bird is never seen during the night by the lantern of the lighthouse is cited as an additional proof that the long migration from Northern Africa is performed in one uninterrupted flight (p. 45). It will be noted that the flight is first stated to travel between Central Africa and the north of Scandinavia, but in

other places is said to be conducted no further than the west of Central Norway (p. 66). It will be also gathered—"that the species does not winter further west than *Central Africa*, nor do its breeding quarters extend further to the *westward than Norway*, there can therefore be no doubt as to the identity of the examples found in Heligoland with those from *Central Africa*," (p. 66).

Before discussing in detail these various passages in the life-history of the Bluethroat as observed at Heligoland, it will not be inappropriate to remind the reader of Herr Gätke's own words (p. 59) on the danger "of basing on observations of this nature the line of arrival or the migration-front of a species, or to draw conclusions from them, as to the velocity of the migration flight," &c., &c.

First in order, it will be as well to again examine the evidence in favour of a rigidly performed flight from north to south or the reverse, according to the seasons, for in the opinion of the author this is only departed from in the rarest instances, and it is on the accuracy of this theory that his estimates of the velocity attained are in the main dependent. Writing on the autumnal flight he remarks—(p. 37) "It hence follows most decisively that the bird, in autumn, rigidly adheres to a southerly course of migration, and travels in a broad migratory front which corresponds to the longitudinal range of its nesting area, and of which Heligoland forms the most western limit. Even a slight westerly deviation from their southerly course of such species (individuals?) as breed in the west of Norway could not fail to convey large numbers of these birds to the east coast of England, and their all but total absence there furnishes therefore an undoubted proof of the persistency with which the southerly course of migration is in this instance adhered to." As previously observed, Herr Gätke's information relating to England is quite at fault, for recently hardly a year passes without records of the occurrence of the Bluethroat on our east coast—curiously enough, many of them coming from the pen of Mr. John Cordeaux, to whose notes he so frequently refers. He has also quite ignored the considerable flock which arrived on the north Norfolk coast in September, 1883, though the latter fact is fully recorded in the reports issued by the Committee on the Migration of Birds, and he himself

alludes to it in the chapter on the Reed Bunting (p. 380). He further adds that the present species has never been met with in France and Spain. The paucity of observers in the latter countries would sufficiently account for this, though as regards Spain the statement is not quite accurate, Colonel Irby stating that the Northern Bluethroat has occurred near Malaga and Valencia, on the authority of Arèvalo ("Ornith. Straits of Gibraltar").

It will be further found that the winter quarters of this species—which are variously stated by Herr Gätke to be located in Egypt, North-eastern and Central Africa (to what part of Africa the latter designation is to apply is not very clear), and again, on p. 267, referring to those which nest in northern Europe, in Egypt, Nubia, and Abyssinia—do not lie in a relative position of due north and south to the breeding grounds. The flight, therefore, of a flock from the north of Egypt to the Dovre Fjeld, in Norway—which, according to Herr Gätke, is the locality where the Bluethroats calling at Heligoland breed—will not cross the island at all unless a considerable westerly deviation takes place beforehand. Its course *would*, however, cross the Alps; and may the latter fact not give us a clue to the non-observance of the species in intermediate localities? As has before been pointed out, might not these Bluethroats "rest in some lofty Alpine valley" as Herr Gätke suggests is perhaps the practice of other migrants, in his charming opening words on p. 1. This consideration is, apart from the fact of the extreme paucity of observers in Italy. It must also be noted that in comparison with the extent of the breeding grounds in Northern Europe, the winter quarters of the Bluethroat have a very narrow longitudinal area; there must, therefore, be considerable lateral spreading, both to the east and west, on the part of the various flights as they perform their spring journeys.

A few words must be again said as to the identity of the flocks passing Heligoland with the colony breeding in the Dovre Fjeld in Norway. Herr Gätke expects his readers to take this fact for granted without his putting forth the least evidence in its favour, beyond his own theory that the migrations of this Bluethroat are performed in a rigidly-adhered-to, south-to-north line of flight.

When we read of this species passing Heligoland in large numbers, including a few adult males, as late as May 26th, and which are said to be *en route* to a district in the most southern locality of its breeding range, shall we not be justified in assuming rather that flocks travelling so late are migrants to districts in the far north of Scandinavia? As has been before pointed out, Messrs. Seebohm and Harvie Brown record the arrival of the Bluethroat in the Petchora Valley—many hundred miles further north—on the 22nd of this month, by which time, no doubt, the Bluethroats in the Dovre Fjeld will have commenced breeding operations. Moreover, the numbers in which, under favourable conditions, the species is observed, and the duration of its migrations, *i.e.*, end of April to end of May, also point to the fact that the Bluethroats passing Heligoland are travelling to many different localities in Norway and Lapland. How can we, therefore, accept the statement that it is the westernmost extremity of a broad advancing migratory column alone which touches the island? Would it not be more reasonable to assume that the Bluethroats migrating to Northern Europe from their winter quarters in Egypt are travelling in many narrow streams, and that the fact of their non-observance in intermediate countries to the south of Heligoland is partially owing to this mode of flight?

In connection with the latter point, the evidence of other authorities quoted by Herr Gätke (p. 265) are interesting, and point to the possibility that with an increased number of observers the Bluethroat might be found regularly occurring in many intervening districts. He remarks: "Respecting Northern Germany, Sylvia suecica has, according to recent statements, not only been met with in isolated instances; but surprising as it may appear, has actually remained to breed near Waren, in Mecklenburg, and near Emden in Friesland."

As additional evidence in favour of the unbroken character of the flight of the Bluethroat, the fact of its never having been observed at the lantern of the lighthouse is cited by Herr Gätke. But what does this prove? Might not flocks which had broken their journey in some previous locality pass over the island at a considerable height? If this should occur they would not be likely to be attracted by the glare of the light.

The foregoing is a summary of the evidence upon which we are asked to accept the statement that the Bluethroat during its spring flight attains a speed equal to 180 miles an hour. On p. 65 Herr Gätke writes as though he had actually witnessed the performance of this feat, for he remarks: "This little bird *proved* to be capable of flying during its migrations at the rate of one hundred and eighty geographical miles an hour."

This is not all, however, for the acceptance of the "broad migration column" theory lands the reader in further difficulties and requires certain flocks comprising other portions of the flight to accomplish still higher velocities.

If we merely take the north coast of Egypt as the starting point of these migratory Bluethroats, and not Southern Egypt, Nubia or Abysinnia, and bear in mind that according to the theories and statements of the author, normal migration is conducted when meteorological conditions are favourable, in one unbroken flight from their winter quarters to their breeding grounds in Northern Europe within the space of one short spring night, it follows that if thousands occur on a little spot stated to be in the track alone of the most western extension of the migratory column, it also follows that east of this locality, individuals should be travelling in equal abundance. Roughly speaking Heligoland is fifty miles from Schleswig Holstein and from the east coast of the latter for a considerable distance in the same direction the Baltic extends;—a wide expanse of sea, unbroken by islands forming convenient resting places. The Bluethroats, therefore, comprising the corresponding portions of the column, must necessarily fly still further and further before they reach any locality on which they can alight. Moreover, we are told the species only flies by night—setting out from Egypt at dusk and landing at Heligoland an hour after sunrise. It follows, therefore, that the more eastern sections of the flight which have to travel the greater portion and in some cases the whole length of the Baltic, must develop a speed more than double that of their more fortunate companions in the west of the column, though the latter have the least distance to accomplish. It will be gathered too that in certain seasons the latter owing to unfavourable conditions, do not themselves break their

journey at Heligoland. We must assume, therefore, that on these occasions the migratory flocks are aware at the outset of their journey of the difficulties they will meet with, and put forth the necessary additional effort in order to travel the longer distance within the given time. No doubt Herr Gätke had these possibilities in his mind when he remarks on p. 69—"there is hardly a doubt but that the velocity of its migration flight may even exceed this already remarkable figure,"—*i.e.*, 180 miles an hour.

With regard to the statement that the Bluethroat does not migrate by daylight, no account has been taken in the foregoing argument that so late in the spring as May 30th, there is no such thing as darkness from Central Scandinavia northwards.

From a comparatively feeble species we now turn to one whose powers of flight, along with that of its congeners, are well known, viz., the Virginian Golden Plover. There will not be any diffculty in believing that this bird is able to accomplish long flights at a high rate of speed, when atmospheric conditions are favourable. But there are probably few readers of Herr Gätke's work who will be prepared for the statement that this Plover accomplishes an unbroken flight of fifteen hours' duration over a distance of 3,200 geographical miles, or at the rate of 212 miles an hour. This is, however, an indisputable fact according to the assertions of the author. He has arrived at his conclusions from the following evidence. He remarks (p. 68)—"Flocks consisting of thousands of these birds have been met with at a distance of 400 geographical miles and more east of Bermuda, flying in a southerly direction on the way from their breeding places in Labrador to Northern Brazil. The distance between the coasts of the two countries amounts to 3,200 geographical miles, and since there is along this whole stretch of route, not a single point on which the travellers could alight for rest, they are obliged to perform the whole length of this enormous journey in one uninterrupted flight. We may probably assume fifteen hours as the longest spell during which a bird is able to remain on the wing without taking sustenance of any kind. On this assumption, the velocity of flight of the above named birds would amount to 212 geographical miles per hour."

He further adds—"The case of the American Plover just

discussed, further shows how little in need of rest birds are during their migration flight. Large sections of the migratory streams of these birds which are directed towards South America fly across Bermuda in immense quantities. As long as fair weather prevails not one of these birds rests upon its migration journey; only a storm will induce them to alight (J. M. Jones, naturalist in Bermuda). This, too, in spite of the fact that they have already travelled over a distance of 1,200 miles from Labrador." In view of this evidence, why assert that the time during which a bird can maintain its flight without food and rest is limited to fifteen hours? Of course the power of abstaining from food for any length of time will vary both with individuals and species. It may, however, be pointed out that the birds of prey are credited with the ability to undergo abstention for several days without their being weakened thereby. A plover might not be able to accomplish so much as this, but forty-eight hours does not seem an impossible period even to the latter, the migratory flight being continued in the meantime. The hordes of birds which sometimes arrive on Heligoland late in the winter, which have been fairly driven from other haunts by the absence of food, and which arrive in the emaciated condition described by Herr Gätke, are still capable of making flights of considerable length. Nearly all species wintering in the British Isles, for a period of three months, undergo a daily fast averaging fifteen hours' duration. For from mid November to mid February, roosting time is about 4 p.m., and birds are rarely on the feed before 8 a.m. the following morning. In foggy weather the period of fast is often greatly lengthened. Of course they are at rest all the time.

It is of little moment as regards the extent of time during which the particular species under notice could remain on the wing, for Herr Gätke points out that there is nothing to prevent their resting on the surface of the sea, even when moderately agitated, as other species have been observed to do.

But all these estimates of speed, and powers of abstention and endurance, are based on pure assumption, the same is the case with the assertion that these particular flights of plovers are travelling from Labrador to Northern Brazil. It is the theory of a broad migration front travelling in a rigidly maintained north to

south line of flight over again. What evidence is there beyond this mere theory, that the birds breeding in Labrador are identical with those flights observed at, or near to, the Bermudas? Even if this could be proved it would not be sufficient, for it would still be open to question whether they do not, on starting from their breeding grounds, follow the coast line south, perhaps for hundreds of miles before setting out over the sea. There is at this season of the year no reason for any great haste in reaching their winter quarters. According to further evidence quoted by Herr Gätke certain flights of these plovers observed on migration five to six hundred miles east of the Bermudas were variously stated to be travelling due south and south east, thus illustrating in the latter case that the flight is not conducted rigidly between the points of north and south.

In the opinion of Herr Gätke no surprise need be felt on learning that the Virginian Golden Plover accomplishes its migrations at a speed of 212 miles an hour. Observations on Heligoland, he tells us, prove that Plovers, Curlews and Godwits, which fly across the island at a rushing speed during bright, warm afternoons in early summer, are seen to reach the oyster bed over four miles to the east, within the space of a single minute. It would be interesting to know how the flight of these individuals has been followed for so great a distance. In England a curlew a mile away, in the pure atmosphere of the Northumberland moors, is a very diminutive object.

Some light may be gleaned of the way in which the Virginian Plover conducts its spring migration from the report on "Bird Migration in the Mississippi Valley" (Cooke, 1888), where it is stated that this species "Breeds in the Arctic regions, and occurs on migration throughout the Mississippi Valley and Manitoba." Now the breeding grounds will not be ready for occupation, at the earliest, until the first week or middle of June, yet we read: "In the spring of 1884, at Caddo, Ind. Ter., the first came about March 11th; between March 21st and 27th it was noted from lat. 39° in Missouri to lat. 41° 42′ in Iowa and to Chicago, Ill. Then no more records were made until after the April storms. About April 16th it began to move again, and April 24th it was reported from Unadilla, Nebr. and Leeds Centre, Wis.; April 29th, it

reached Heron Lake, Minn., and the first week in May was reported from Argusville and Larimore, Dak. In south-eastern Dakota it is very abundant during migration." A similar account of the migration in the spring of 1885 then follows.

It will be at once apparent that the species commences its migrations long before the breeding grounds are ready for occupation and moreover the journey so far from being performed in one unbroken flight, is undertaken leisurely and in comparatively short stages. Of course this throws very little light on the actual speed at which the various stages are covered, but if this is the character of the migration at the time when birds are said by Herr Gätke to exhibit unrest and impelling haste—"Here we nowhere meet with any attempts at dividing the long migration flight into short convenient stages," he remarks (p. 4).—Would it not, therefore, be safer to assume that the autumnal journey is uncharacterised by one great unbroken flight from the breeding grounds to the winter quarters in South America, but is performed more leisurely and in shorter stages which do not necessitate a speed of 212 miles an hour for their accomplishment within a given theoretical time?

The Virginian Plover is not the only American species which performs its spring migration in the foregoing manner. The Pectoral, the White Rumped, Bairds', Least, and Semipalmated Sandpipers; and the Hudsonian, and Eskimo Curlews, may be mentioned in addition. No doubt if it were possible to make observations throughout the whole of Northern Africa similar facts would be obtained relating to European birds. The uncivilised condition of the greater part of the latter locality, however, precludes the possibility of doing so at present. In America conditions are happily different.

In a later chapter (Exceptional Migration Phenomena) Herr Gätke discusses the incident of examples of the American White-winged Crossbill having been observed crossing the Atlantic in a locality many miles from land. This occurrence may, perhaps, throw some light on certain of his theories as to the length of time a bird can remain on the wing without food, and in the meantime maintain great muscular exertions. The account of this incident as recorded by Professor Newton, in the last edition of Yarrell's

"British Birds," is to the effect that when about 600 geographical miles east of Newfoundland, flocks of this species were observed by Dr. Dewar, crossing the Atlantic before a stiff westerly breeze. Many of the flocks alighted on the rigging of the ship, and of these twelve examples were captured. Occurrences of this kind are so common in the North Sea that Professor Newton very reasonably suggests the opinion that many other migrants may have been thus helped across the Atlantic by human aid; with what success may be inferred from the American element in the list of so-called "British" birds. This does not meet with Herr Gätke's approval, however, who remarks:—"We cannot, however, reasonably admit that cases like that just instanced explain the passage of American migrants to Europe generally." He takes it for granted that these flocks of Crossbills undoubtedly reached the coast of Europe in safety long before their imprisoned comrades. To accomplish this it will be as well to see what feats the former would have to perform.

Herr Gätke tells us that all migrants start on their journeys with empty stomachs. We may, therefore, reasonably assume that these Crossbills were no exception to the rule. The stretch of ocean between Newfoundland and Ireland covers sixteen hundred geographical miles, with no intermediate resting-place. To cover the distance in the time he assigns as the limit during which a bird can remain on the wing without food and rest, viz., fifteen hours, will require a speed exceeding 100 miles an hour. Now, according to his observations on Heligoland, a stiff westerly breeze would be unfavourable to the performance of migration at low elevations, birds rising to vast heights during the prevalence of such conditions near the earth. These Crossbills, however, were flying so low that they took advantage of the presence of the ship which afforded them an opportunity for a rest. This species, moreover, is by no means an expert flyer. Does it seem at all probable, therefore, that under the adverse conditions encountered these flocks actually reached the west coast of Ireland in safety? Could a Crossbill, even under favourable conditions, fly at the rate of one hundred miles an hour, and maintain this velocity for sixteen hours without a break?

Common observation has revealed the fact which is confirmed

by instantaneous photography, that the majority of birds fly with the plane of the body slightly directed upwards. The maintenance of a high rate of speed when a strong wind is blowing from behind, becomes therefore almost a necessity. For whereas the before mentioned position of the body enables a bird in meeting a moderate wind to sustain itself in the air with a minimum of effort, it will have the contrary effect with a wind blowing from behind, unless the speed attained by the bird is much greater than the force of the latter. It is very doubtful, however, whether a poor flier like the Crossbill would have sufficient strength to maintain a great velocity for any length of time. A stiff westerly breeze would not, of course, even approach a force equal to 100 miles an hour.

Herr Gätke has formed the opinion that birds are not in the habit of breaking their journeys during either migration flight until after the greater part of the distance has been covered. He seems to have come to this conclusion from the fact of the very short stay the great majority of species make on visiting Heligoland. "After a night's incessant flight," he remarks, "a greater or smaller portion of the succeeding day is all the birds need for satisfying their hunger or recovering from such fatigue as may have resulted from the exertions of their journey. I myself have never noticed cases of fatigue or actual exhaustion such as people tell about birds of the Woodcock family on this island, in regard to any birds which have landed here during their migration either by day or night." To the writer, in view of the numbers of dead birds washed up on our shores, and the observations of other ornithologists, amongst whom Mr. Eagle Clarke's remarks are especially interesting (*vide* "Digest of the Observation on the Migrations of Birds"), the above statements are good evidence that the majority of the callers at the island have travelled over only comparatively short distances prior to their arrival at Heligoland. Indeed, the position of the island, surrounded as it is on three sides by large land-masses at only moderate distances, lends itself to this view. Those species which breed in the north are undoubtedly governed in their forward movement by the early or later departure of winter in the lands towards which they are travelling. The late Mr.

Seebohm's observations in the Yenesay, some four hundred miles from its mouth, form undoubted proof of this fact. As he awaited the break up of the frost at a post on the Arctic circle, he notes that prior to the melting of the ice on that great river few birds arrived. As soon, however, as this commenced migrants in small numbers immediately appeared. Some too eager to advance had to retrace their flight. We cannot think that any of these, in their far-off winter quarters were aware of the state of the weather some thousand or fifteen hundred miles to the north. Undoubtedly they migrated to the verge of the frost at some much earlier period, and had followed its daily retreat to the north until his post of observation was reached, their journey being governed by the break up of the ice, which in Mr. Seebohm's opinion takes place at the rate of one hundred miles a day.

The intrinsic weakness of Herr Gätke's theories on the velocities maintained by birds during their migratory flights will be apparent, when he has to call in their aid :—" The assistance of other factors besides the mechanical instruments of motion with which the bird is equipped " (p. 72), to make these accomplishments possible. His concluding words to this chapter are peculiar and significant. They read as follows :—" In treating of the height of the migration flight, we have considered in detail that birds, as distinct from other warm-blooded creatures, are provided with a respiratory mechanism enabling them to remain for any desirable length of time in regions of the atmosphere so rare in density and poor in oxygen, as must necessarily result from elevations extending to 40,000 feet ; and we have further seen that they are, in addition, provided with a very extensive system of air-sacs which they are able to fill or empty at pleasure. . . . Their sole purpose, therefore, is evidently to enable them to perform those wonderful migrations—wonderful, both as regards the height at which they proceed, and the velocity with which they are carried out. If birds were restricted during their autumn and spring migrations to the same low strata of the atmosphere in which they move during the rest of the year, such of them as have to perform their migratory journeys early in the spring or late in the autumn would, in many cases, be obliged, in consequence of stress of weather, to let the proper period of their migrations pass with-

out having been able to make a start on their journeys." The little aid furnished by the air-sacs to a bird during its migration has already been pointed out, and apparently recognised by Herr Gätke. It is probably true that they may be filled or emptied at pleasure, but whether a bird has the power of retaining their contents or keeping them void is quite another matter. The objection that birds might be so detained by stress of weather—unless they performed their migrations at great speed and at a great height—as to prevent their reaching their breeding grounds at all, is overcome in so simple a manner, *i.e.*, by their migrating in shorter or longer stages as opportunity allowed, that it is rejected by Herr Gätke, apparently for this reason alone. "To withdraw themselves," he further adds, "from the disturbing influences which are apt to prevail in these changeful lower strata birds mount up into the more elevated layers of the atmosphere, in which more uniform conditions prevail, and which are less subject to powerful meteorological disturbances. In this way, however, they reach elevations at which the resistance of the air is so insignificant as to render possible the astonishing velocity developed during the migration, while this velocity at the same time counteracts any tendency towards sinking, a slight elevation of the anterior margin of the horizontal wing surface being amply sufficient to effect this object."

All of this has already been commented upon, but why the author should imagine birds must ascend to these heights to accomplish their migrations, when—in the light of his own assertions—a sluggish flyer, like the Hooded Crow, or an expert one, like the Virginian Plover, can develop respective speeds amounting to 108 and 212 "geographical" miles an hour, at a height of only a few feet above the surface of the land or sea, is most difficult to surmise.

THE CAUSE OF THE MIGRATORY MOVEMENT AND WHAT GUIDES BIRDS DURING THEIR MIGRATIONS.

HOUGH Herr Gätke has devoted separate chapters to the discussion of these two features of the phenomena of migration, they may be conveniently examined together, for it will be found that one, not unnaturally, throws light on the other.

At the outset it may be stated that in neither case does he put forth any explanatory theories of his own; indeed, he frankly confesses his disinclination to even enter upon such a hopeless task.

The following paragraphs are an attempt to embody the views which have found most general acceptance as to the "cause of the migratory movement," supplemented by a few suggestions on the part of the writer.

The principal factor necessitating these long journeys on the part of birds from their breeding grounds, to winter quarters in distant lands, is undoubtedly lack of food; cold of itself, would probably not have sufficient direct influence on the majority of species to induce them to leave the homes to which they seem so devotedly attached. Nevertheless, the prime originating cause of the habit was, undoubtedly, the setting in of rigorous conditions in what was probably their ancestral home, thus necessitating its temporary abandonment. A low temperature of any duration accompanied by a heavy fall of snow, means, to the great majority of birds, the cutting off of all food supplies. Geological evidence is pretty conclusive that at one time those regions in the north which now endure the severities of an arctic winter, previously enjoyed a fairly equable climate, perhaps akin to that of our own islands at the present day. At the former period these

northern countries, no doubt, supported an abundant and resident avian population. Opinions, however, differ as to the duration of daylight which prevailed so far north during the winter months. Some hold that simultaneous with a temperate climate there existed a proportionate amount throughout the year. Others, again, think that the duration of the latter was no greater than at the present time. In the opinion of the late Henry Seebohm, the Polar Basin was the ancestral home of the great family of the Charadriidæ, and the earliest members of this group performed their first migration, not in search of food alone, but in quest also of light.

It will not be necessary to speculate on the latter probability, though this additional reason for migration should be by no means ignored. It will be profitable, however, to examine the daily lives of certain sedentary species of birds in our own country at the present day, for it is not unreasonable to suppose that their habits correspond to those formerly living in the Arctic regions at the time the latter enjoyed a temperate climate. There seems to have been innate at all times in birds, with the exception of a few species, a passionate love for particular localities, not only in the selection of nesting sites, but also for familiar winter haunts and roosting places. Professor Newton, in his "Dictionary of Birds" recounts some interesting cases illustrating this strength of attachment to the former. The most remarkable instance to which he refers is, undoubtedly, the return of a pair of Stone Curlews—a bird of heaths and open countries—to a nesting site which had become the centre of a plantation. To these favoured localities the same birds, or their offspring, return year after year, either to nest or to spend the winter.

The early arrival in Great Britain of the Chiff-Chaff and Wheatear is typical of this strong desire on their part, to return to their breeding homes. The latter has on two occasions been known to reach the south-west of England as early as February (*vide* "Migration Reports") and the former regularly arrives by the middle of March. Nidification in either case not commencing until six weeks later. Further evidence to the same effect may be gleaned from the movements of Skylarks, Starlings, &c., at Heligoland (p. 5).

From these familiar haunts birds make those daily journeys which fill up the stories of their lives. In the breeding season material must be sought for and carried to the nest, next the female must be fed as she broods, and eventually the young when they are hatched. In the autumn and winter, when food is much scarcer, those species like Curlews, Lapwings, Rooks, Daws, Starlings, and many others, band themselves together into flocks, setting out at particular times from the common roosting place on their daily forays, which often extend for many miles, and to which they return as regularly as the hour of sunset approaches. These latter daily journeys are just as much migrations as are the great movements of the present day. The difference is in degree not in kind.

The writer recently experienced an amusing instance of this clock-work regularity of life carried out by an old male Blackbird. This individual was observed throughout a whole winter, to pass at dusk with the utmost regularity a shelter, erected at a duck marsh. This bird always flew down the same hedgerow and in the same direction, and always at the same speed and elevation. The following winter, apparently, the identical Blackbird was observed to carry out the programme exactly as before.

Such facts which might be multiplied, *ad. lib.*, all point in one direction, and form undoubted proof of the excellent memory of locality possessed by birds.

It happens at times, however, on the advent of exceptional cold, that these regular habits are disturbed, and daily migrations in search of food have to be prolonged to such a distance, that a return during daylight becomes an impossibility. Residents in particular localities are therefore driven from their customary haunts to other districts, usually on the outskirts of the area affected by the frost. There they manage to exist until a thaw enables them to satisfy their longing to return. All species will not be affected in the same manner. Many like the Buntings and Finches, draw near to the habitations of man, where around stackyards, and the outskirts of villages and towns they manage to maintain themselves until better conditions prevail. In thickly populated countries, cultivation has had an

appreciable effect on migration, which should not be overlooked. There can be no doubt that were it not for the latter, hundreds of thousands of Finches and Larks would have to seek sustenance elsewhere. In the same manner individuals of other species, like the Hooded Crow, of which the great body regularly migrate, are enabled to find an existence near villages, even in high northern latitudes. Seebohm and Harvie Brown's observations on the Snow Bunting in the Petchora Valley will also illustrate the foregoing remarks (" Siberia in Europe ").

It is only necessary to imagine the before-mentioned conditions prevailing in Northern regions to see how the great migratory movements of to-day have been developed, and how birds have acquired that power or sense by means of which they are able to unerringly find their way during the long journeys they now accomplish.

As has been previously pointed out the movements of birds, will, until the cold became very severe, have been confined to those daily wanderings in search of food before described. But as the spells of frost grew longer and more severe and their extent affected a larger area, so will the distance to be traversed have increased and the intermittent opportunities for return, or attempts to return, to the familiar home have grown less frequent. At the same time the attachment to the old haunts will not have diminished, and on the other hand the power of finding their way and the sense of locality will have constantly become more and more acute owing to the new surroundings requiring their daily exercise.

It now remains to be seen in what direction these early migrations were likely to have trended. Whether we assume that it was want of light or want of food which first induced birds to temporarily forsake their original home is not of much consequence. Both would be felt most severely in the north. The general tendency, therefore, will be to wander in the opposite direction. The effects of severe frost will be least apparent along sea coasts, the shores of lakes and in river valleys; indeed at almost all times of the year food is found in such localities in greatest abundance. It seems natural to suppose, therefore, that those individuals and species which

followed the courses of the latter in their retreat before winter, would have the best chance of maintaining themselves alive. As the cold advanced from the north, birds will thus have early acquired the habit of following coast lines trending to the south, or some point approximating thereto, and those river valleys whose course runs more or less in the same direction. It must not be imagined, however, that without these guides, which were, perhaps at most, merely guides to food, birds could not have found their way, but that their presence in large numbers in such localities is due—as Herr Gätke himself points out (p. 36) is the case at the present day—to actual necessity. But what was once a necessity has since become a habit. It may be urged against this theory that the height at which many species now conduct their flights, is strongly against the probability of the assumption that birds ever followed the courses of coast lines and rivers. It may be admitted that the latter have now ceased to be followed as guides. It is even doubtful if this were ever the case except unconsciously so, but there can be little doubt that the old routes of migration are still adhered to simply from force of inherited habit. It is highly probable that the movement at its earliest inception and perhaps for a vast number of years afterwards was carried out at low elevations and in daylight, after the manner of those supplementary migrations occurring late in the winter, or those short peregrinations to which Herr Gätke alludes on p. 46. The habit of migrating by night was most probably acquired at a later date and may have arisen from the fact that the daily breezes both in spring and autumn, except in the case of very strong winds and gales, are apt to die down at sunset, the hours of darkness being characterised by calm. It is a curious fact that the Hooded Crow—one of the regular day-fliers—is declared by Herr Gätke to be more indifferent to the state of the weather than all other migrants.

So much has been said with regard to migrations over the land. But the question arises—By what means did birds first acquire the habit of crossing wide seas to winter quarters, of whose very existence we have no reasons for thinking they were cognisant? The subject is fraught with the greatest difficulty

and various theories have been put forward in explanation, but we may fairly assume that the pioneers of these latter movements were only driven to undertake such a perilous flight under pressure of urgent need. It seems highly probable that accident, or at any rate meteorological conditions had a great influence on the ultimate bourne at which these first flights arrived. No doubt numbers perished, as they do even at the present day, but still sufficient survived, who were impelled by the love of their old haunts to retrace their steps when the conditions had ameliorated. The theories of land-bridges, old coast lines, or groups of islands, since submerged by geological changes, have been put forward by certain ornithologists as explanatory theories of the manner by which this habit of crossing wide seas has been acquired. No doubt there is much to be said in their favour, and that their influence on the path of migration is still traceable in various localities at the present day.

Emigration, or the extension of the breeding range of species has also had its influence on migration. Species have extended in various directions, some from the south, others from the south-east, or even east. Those from the south will have thus met the cold in its advance, or followed it in its retreat, but the manner in which they have acquired the habit of migration will not be essentially dissimilar to that which has already been described. Nevertheless, there are cases in which birds migrate from their ancestral home in the south to breed in the north. According to Seebohm the Swallows are an example of the latter phenomenon.

It now remains to add a few remarks on the evidence in favour of the possession by birds of an acute sense of direction and locality. It has been previously pointed out that so far from enunciating any theory of his own as to "What guides birds during their migrations," Herr Gätke frankly avows himself disinclined even to undertake the task. The chapter in his work he devotes to the question is, therefore, nothing but a statement of his objections to the theories of others; to only one of which does he appear to give even partial adherence.

It is, perhaps, not to be wondered that he should feel disinclined to put forth any theory of his own, committed as he already is to the statements on the direction, altitude and

velocity of the migration flight as detailed in previous pages. No theory that could be devised would be likely, in all its details, to fit in with such various speculations, and he may well look upon the task as hopeless.

In remarking on this wonderful power by means of which birds find their way over such vast distances, his prefacing words (p. 131) are not unopen to objection. He writes: "Man, in spite of his senses and intellectual faculties, is not able to continue moving in a straight line for even as much as a mile in complete darkness or dense fog." A power of this description varies greatly with individuals and even races, and the possession of this sense of direction is very difficult of realisation by those who are not so endowed. Complete darkness, moreover, is not a condition of the atmosphere with which either man or birds are familiar and there is abundant evidence to show, even in Herr Gätke's book, that fog is just as puzzling to the latter as to the former. It is an undoubted fact that in savage or nomadic man this sense of direction, or power of orientation is highly developed. Indeed, its possession is almost a necessity, for without compass or other instruments, and with no knowledge of astronomy, nomadic tribes have to undertake long journeys over desert and trackless tundra in search of sustenance for themselves and their domesticated animals. Man, of course, is in one respect at a great advantage in comparison with birds, by reason of his ready powers of intercourse with his fellow-men. A company of savages will undoubtedly be more certain of eventually reaching their destination than single individuals of the tribe. Naturally the most experienced members of the company will be chosen as pilots on these occasions. But here in the case of birds, a difficulty arises, for it is undoubtedly a fact that it is the young, in the great majority of species, which first set out from the breeding grounds on the autumnal migration, and there is no reliable evidence to prove that they are accompanied by older and more experienced individuals as guides. Certain leading ornithologists, however, have held the opposite view, and even so great an authority as Seebohm states that the young are led by those barren or otherwise non-breeding birds which are the *avant courières* of the migratory hosts ("Geog. Distribution Charadriidæ").

No one appears to have called attention to the fact that whereas the hereditary desire to leave the breeding grounds in the autumn appears to act with the greatest force in the case of the young of the year, the desire to again return thither appears on the contrary to be greatest in the oldest and most vigorous males. If this assumption is correct we may reasonably suppose that the hereditary impulse to leave the breeding grounds loses strength as the individual grows older, whilst the desire to return thither at the earliest possible date, on the other hand seems to gain additional force. These considerations may even point to the fact that it was the young which first set out on those daily journeys in search of food before described, and may shed some light on the theory that they feel the influence of the hereditary desire to migrate earlier in the autumn than do their parents.

Herr Gätke points out that those migratory flights occurring late in November and December are composed exclusively of fine adult males of various species. No doubt, unless compelled by the advent of exceptional cold, these old and robust individuals would have remained on the outskirts of the frost until the following spring. At the same time it must not be forgotten that at one period winter in the north most probably set in much earlier than it does at the present time.

It has already been pointed out that birds are possessed of a very highly developed sense of locality or direction. It remains to be shown how young birds, with the aid of this power, are enabled without previous experience to migrate to winter quarters which they have never before seen. The desire to migrate is due, as has already been stated, to hereditary impulse to leave the breeding grounds. The manner in which this impulse has been acquired has also been described. To the writer there is no difficulty in assuming that the possession of the sense of locality and direction is also due to heredity. This view gains additional force from the fact that this power of orientation varies both in individuals and tribes, not only with man but also and in the same degree with birds, both as regards individuals and species. Amongst the latter it is those species which are the most migratory who possess the sense in its highest development, whilst those on the other hand who perform no

regular migrations, and have consequently no accustomed winter quarters, are most erratic both in choice of the latter and of their breeding grounds. The wanderings of the Bohemian Waxwing, Rose-coloured Pastor, and the Common Crossbill may be pointed out as well-known instances of these erratic habits. Why, therefore, should not the latter species be equally endowed with this sense of locality and direction, unless it is because this faculty has been acquired through slowly inherited experience.

Herr Gätke, however, objects to theories of this kind on the grounds that the term unconscious inherited experience is nothing but another name for instinct. He remarks: "Can experience be something of which the subject is altogether unconscious; and further, can experience, the result of which is positive knowledge, be actually inherited?" To the writer he has here fallen into the error of confusing inherited experience with experience gained during life. Unconscious inherited experience is the sum total of the latter acquired during the lives of many previous generations—the experience of the race not of the individual. We see all around us every development of the nest building instinct from the lovely structure of the Long-tailed Tit to the simple depression in the sand of the Oyster-catcher. The former species by inherited experience—unconscious why it does so—selects materials in building its nest which will harmonise with the lichen-covered branches of trees, thus rendering the nest inconspicuous. Were it conscious of the reason for selecting such material, however, it would hardly make the frequent blunder of placing the nest, early in the spring, in some hedge-row, where these very materials have exactly the opposite effect, the foliage not being sufficiently advanced to afford the necessary concealment. There can be no doubt that the natural site for the nest of this species, and indeed, which is most often selected, is the fork of some lichen-covered tree.

That the instinct or hereditary impulse varies in strength, not only in species but also in local clans of the same species, there is abundant evidence to show. Many birds which are strictly migratory in the north of Europe are sedentary in our own country, and moreover, the latter on the advent of exceptionally severe winters of long duration, perish in large numbers, appa-

rently from utter lack of this impulse to migrate. In the experience of the writer the Mistle Thrush is a bird whose resident numbers fluctuate considerably from this cause; other species are no doubt affected quite as much. The colony of Curlews in West Cumberland, which breed in the fells and winter on the neighbouring coast, which ordinarily enjoys a very mild climate, suffered severely in the arctic winter of 1894 and 1895. An examination of dead birds on the beach revealed more of this species than of any other, and it proved to be correspondingly scarce in the breeding grounds the following spring.

Many Redwings winter in England whose migratory instinct seems to be quite evaporated by the time they have arrived here. It is notorious how they suffer during severe weather, though a short further flight would convey them to a place of safety. Mr. Eagle Clarke recounts instances of several other species whose migration instinct, though it carried them to the limits of their customary flight yet failed to land them to a place of safety in the exceptional winters of 1881-2-5-7 (*vide* Digest).

In localities, however, where severe winters though not the rule, are by no means infrequent, the migratory instinct may be encountered in still different degree. Herr Gätke in several places alludes to late movements on the part of large numbers of Plovers, Curlews, Sandpipers, Finches and Larks (p. 19). These latter flights may have been termed supplementary migrations. The individuals comprising them appear to hold the intention of wintering in some locality not far from Heligoland, but on the approach of severe weather are forced to make a further move, thus illustrating the fact that though in ordinary winters their migrations would have already come to an end, still, from greater frequency with which severe weather recurs in these localities the migratory instinct to undertake a further move has not been lost but is simply remaining dormant for the time being.

Other hardy species again will illustrate the winter lives of birds, existing at the time migration had its first inception. Herr Gätke's graphic description of bird life at Heligoland when the Baltic becomes frozen very far south, and large masses of ice collect about the mouth of the Elbe forms a most striking picture of the latter phase of the phenomena.

Enough has now been written on the varying degree of strength in which the migrating instinct is present in local races and species of birds. It may be here remarked that the term hereditary instinct or hereditary impulse, has been objected to on the grounds that it is merely a method of evading a difficulty or expressing our ignorance of the means by which an animal or bird is impelled to perform, or accomplishes certain actions. Such terms, however, are a necessity, and the objection loses its force when the instinct or impulse can be proved to exist with different species in greatly varying degree. We can never expect to understand the actual mechanism or process set in motion in the brain, either in following out a thought or performing an unconscious act. Possibly if we could communicate our difficulty to a bird we might get a similar reply to that which Von Middendorf—who first promulgated the theory of a "sense of direction," —received from the Samoyede, whom he questioned on this point. "Well," answered the latter, after regarding him with surprise, "how is it that the little arctic fox finds her way on the great Tundra without ever going astray?" This Samoyede, though conscious of his own powers, was quite as much at a loss to account for their possession or how they acted, as we ourselves would be if called upon to explain the various mental processes taking place in our own brains.

Beyond the bare statement that such is not the case, Herr Gätke produces but little evidence in opposition to the theory that migration is conducted at lower elevations during the hours of darkness than is the case during bright clear daylight. Evidence collected at lighthouses and light-ships, however, seems to point to the truth of this assertion. In view of this fact it may be remarked that there is some evidence in favour of the theory that sight comes in as an additional aid to the sense by means of which birds are enabled to find their way. We can hardly imagine a "sense of direction or locality" to be so acute as to enable any bird like a Wagtail or Flycatcher to set out from its winter quarters and accomplish the whole journey without a halt, to some familiar field or garden, containing the cowshed, or summer-house, on the door-hinge of which it had been in the habit of constructing its nest. Of course in the case of young birds there can

be no such thing as landmarks, but with older individuals we can imagine that while this sense of direction enables them to land on a particular stretch of coast, perhaps at the mouth of a river, whose course they follow, it is by power of memory, aided by familiar landmarks, that they eventually reach the desired goal. These latter portions of the flight are no doubt conducted in short stages and during the hours of daylight. Travellers in northern countries make little or no reference to migration by night, though this is so great a feature of the movement in temperate regions. The concluding portions of these journeys may thus traverse very circuitous routes. Observations conducted by the writer in a limited locality have proved beyond a doubt that certain species reach their breeding grounds from a direction entirely opposite to that which might have been expected, from our knowledge of the general trend of the spring flight. Moreover, other species at the same time cross this flight at an acute angle in travelling to districts further removed.

It will not be uninteresting at this stage of the argument to follow in imagination, the migratory flight of a flock of birds, conducted in the normal manner, according to the theories of Herr Gätke, from their breeding grounds in the north-east to their winter quarters in the west or south-west of Europe. Let us suppose that we are dealing with one of the "many hundreds" which pass Heligoland on their journeys from "far eastern Asia."

It is dusk—and the time for departure has arrived. Without more flocking together than has accidentally taken place during feeding time, all the residents in a particular area set out from their breeding grounds on a journey of two thousand miles or more. No food has been taken for some hours, and the winds being unfavourable near the surface of the earth, all rise to a height of at least 20,000 feet, whence guided by some unknown power, and at a speed of from 150 to 200 miles an hour, they set out on their rushing and undeviating flight to the west of Europe. Here, however, the direction of the latter must be altered and a turn to the south executed in mid-air, which carries them, after a further flight, to the neighbourhood of Heligoland, where again a second turn is accomplished and the remainder of the journey is

performed in the old undeviating westerly direction, until dawn finds them at their goal on the shores of England; neither tired nor hungry after their great exertions.

This programme may not be carried out in its entirety by all species, but to the writer it forms a true sketch of migration under normal conditions, according to the theories of the author.

Von Middendorff's theory of a "sense of direction" possessed by birds, has already been discussed. There remains, of those mentioned by Herr Gätke, that of Professor Palmén. The latter ornithologist, after selecting certain well-known species, carefully accquired all the information he could obtain from the notes of travellers and local investigators relating to their progress across the Eastern Hemisphere. He then mapped out what he considers are the chief routes these particular species follow during their journeys. In all cases the latter traverse sea coasts or great river valleys, from which fact the Professor argues that these natural routes are followed by migrants as guides to their destination. In referring to this theory, Professor Newton, in his "Dictionary of Birds," remarks: "One of the routes (X) [*i.e.* starting from Greenland and Iceland, passes by the Faroes to the British Islands and so joining the second (B) and third (C) runs down the French Coast], described by Professor Palmén, and one of considerable interest to dwellers in the United Kingdom, is extremely questionable. Indeed, the *data* to establish its existence were not forthcoming when he wrote, and probably are not forthcoming now, though in the interim much has been done toward the collection of facts at light-houses and light-ships around our coasts by the 'Migration Committee' appointed by the British Association in 1880." It is, therefore, very interesting to find that Mr. Eagle Clarke, who approached the subject without any preconceived theories or bias, confirms Professor Palmén's statement, in his digest of the information collected by the above Committee.

Herr Gätke, however, does not even enter into a detailed criticism of these theoretical routes. In alluding to them he remarks:—"Observations in nature on the author's own part appear not to have been made the basis for this work,"—which is as much as to say, that observations, unless personally con-

ducted, are not of sufficient reliability on which to establish a theory. He also considers that he has sufficiently explained his views on the direction of the migratory flight in a previous chapter, and that any closer examination of Professor Palmén's arguments is therefore unnecessary.

When refuting the theories of other ornithologists, Herr Gätke is apt to bring forward those enunciated by himself, as though the latter were equivalent to undeniable facts. However satisfactory they may appear to himself, it would have been better to have awaited their general acceptance before adopting so arbitrary a method of argument. The allusion to his own assertion on p. 140 that it is quite within the power of a bird to cross unaided the entire Atlantic from Newfoundland to Iceland in nine hours, and the frequent references to his own estimates of the speed attained by the Carrion Crow and Bluethroat, are cases in point.

No theory that has yet been brought forward will, perhaps, account for the means by which every individual species, which may perform an exceptional migration, now finds its way. In objecting to the statement that many birds at the present day conduct their flights over the sea, where at one time there existed groups of islands, or perhaps peninsulars, forming so-called land-bridges, Herr Gätke refers to the case of the Virginian Golden Plover, which species, according to his own views, migrates in one unbroken flight from Labrador to Brazil. Along the whole course of this journey there are no traces that any such land-bridges ever existed. Setting aside the fact that neither has the identity of the flocks passing the Bermudas with the Labrador birds been proved, nor has the exact point at which the latter leave the mainland been ascertained; it does not seem to have occurred to him that this long flight is the outcome of a series of migrations gradually increasing in distance. Apparently, he seems to think that conditions suddenly arose in Labrador necessitating a flight from thence to Brazil, without any intervening development.

It seems far more reasonable to suppose, however, that this flight has gradually grown from short intermittent journeys along the Atlantic coast, which gradually increased in extent as the

conditions necessitating its commencement extended their area. How those individuals first commenced to fly over the sea it is impossible to say. Before the migratory habit was initiated they can have had no knowledge of Brazil. Perhaps the general direction of the winds which are westerly at the present day and may have been so at that period, had their influence on these early flights. In the meantime, inheritance will have had ample time to accomplish its work, and the accumulated experiences of thousands of generations will have sufficiently developed the sense of locality by means of which these flights are able to find their way over the pathless tracts of the Atlantic at the present time.

Herr Gätke in several places in his work compares the so-called migrations but properly speaking emigrations, of insects with those of birds, bringing forward the case of the former as an objection to the theory that the sense by means of which birds find their way has been acquired and transmitted through inherited experience.

To the writer the migrations of insects are of quite a different nature to those of birds. In the first place they are of most irregular occurrence, and are declared by the author himself to be due to the prevalence of certain meteorological conditions. The only bird migrations which they at all resemble are those of Pallas' Sand Grouse, which latter are emigrations in the true sense of the word. It is generally assumed that this species has always followed the same course during its irregular movements, but to the writer it seems very probable that other flights may have emigrated to quarters in opposite directions. In the second place the insects composing these flights never return to the place of their departure and it is not known for certain that they ever land on a coast at any distance away.

In the third place it is very doubtful if an insect like Plusia gamma, to which Herr Gätke specially refers, has the power of crossing the North Sea; its speed of flight being no greater than that accomplished by an entomologist intent on its capture, as the writer knows from experience. The simultaneous appearance in Lincolnshire of this species in great abundance, with the advent of large flights at Heligoland, has no significance whatever. This abundance is by no means confined to the former county and has

been equally marked all over England. As an instance of the profusion in which this insect has occurred in the Midland counties, it may be stated that the writer took upwards of thirty pupæ of it from a carrot bed only a few feet in extent and after a very superficial search. The imagoes emerging from all of them within a few days of one another.

We know, however, far too little of the lives of insects to draw any conclusions from their emigrations. But the absence of many species from England which are common on the continent in localities at its nearest points to the latter is significant, and points to the fact that migration in bulk rarely, if ever, takes place.

There is another well known species of insect which has occurred in great profusion throughout England at irregular and usually widely separated periods, viz., the clouded Yellow Butterfly (Colias edusa).

In the year 1876 a few occurred in certain localities in the Midlands, as well as in other parts, late in the summer; but in the following year, 1877, the species simply swarmed. Now of the very numerous examples captured by the writer and his friends, not one exhibited any signs of having undertaken a long journey. All on the contrary had the appearance of having newly emerged from the chrysalis. There can, therefore, be no question that the larvæ had been hatched locally and that the great abundance of the species was due to the prevalence of certain favourable conditions of the nature of which we are quite ignorant.

The abundance of Plusia gamma, which, however, is at all times a common insect, may, no doubt, be attributed to a similar cause.

Of the other species mentioned by Herr Gätke, certain of them are such feeble and lethargic flyers that a journey to any distance beyond the island is simply an impossibility.

It will be noted that on one occasion, viz., August 19th, 1882, a strong migration of birds took place accompanied by thousands of Plusia gamma. "A thunderstorm with high winds, subsequently put an end to the migration" and no doubt put an end to the individuals comprising the flights of Plusia gamma at the same time.

To the writer these migrations of insects partake more of the nature of a stampede of animals, but unlike the latter probably arise from some more natural cause, but for all this the direction followed may be just as erratic. It is an interesting fact, however, that during the prevalence of east winds Noctuæ fail to be attracted by the sweets provided as a lure by the entomologist on a "sugaring" expedition. Indeed, in this country, during such conditions, insect life is not much in evidence.

In his opening remarks on the "cause of the migratory movement," Herr Gätke notes, that "it would be interesting to discover what induces birds wintering in the more southern parts of Africa, where they are subjected to hardly any changes of climate, suddenly to leave these stations for their breeding homes in the north; or again, what it is that urges the individuals of a species, the nesting stations of which are situated say, in central Germany, to start on their journey a month earlier than other members of the same species, the breeding homes of which are in Northern Scandinavia, and which have been passing their winter in North Africa. The later allow the migrant stream of their more southern kinsmen to pass over them unmoved, as though they were fully conscious that their own time for departure is not yet ripe and that their breeding quarters are still held bound in the depths of winter."

It may be questioned whether it is possible to prove that any species breeding in Central Germany migrates to the southern parts of Africa to winter there. The general opinion on this point is, that the local race of a species breeding in the former country, would more probably winter in Northern Africa, and that it is the more northern races which winter further south. "The higher a bird breeds in the north, the further south it migrates to winter" has become almost an axiom. But apart from these considerations, the explanation of the above phenomenon probably lies in the fact of the earlier activity of the breeding organs which recurs at this period of the year coupled with the innate tendency to return to their original homes at the same period, which must set in in the case of the individuals migrating to breed in Germany some weeks before it takes place with those breeding in the north. The fact that non-breed-

ing birds are the last to start on their migrations lends additional evidence in favour of this probability. We are driven to an explanation of this kind in preference to admitting that birds wintering a thousand or fifteen hundred miles away are conscious that their breeding grounds are fit or unfit for occupation. However, the foregoing theory will not suffice in the case of the autumn flight. It is undoubtedly a fact that this movement commences with one or two species, a few weeks at most, after the close of the breeding season. The early migration of the young of the Starling is a well known case in point. In this particular instance the explanation of this early migration on the part of the young may perhaps be attributable to a diminishing supply of food. The latter fact may arise from a simple cause, *i.e.*, the drying up of the countries inhabited, with the consequent disappearance of worms and slugs on which the young feed, owing to the summer heat, and the growing scarcity of larvæ, which at this period of the year will be undergoing their metamorphoses under ground, preparatory to their emergence as imagoes in the autumn. It is interesting to note that in our more pluvial climate, the young of this species do not migrate like their relations on the continent. However, we know so little of the former extension of the breeding ranges of any species, so that such explanations must always remain more or less conjectural. If we knew that the Starling at one time bred in the high north, it would be within the bounds of possibility that the early migration of the young was the survival of a former necessary habit. It has already been pointed out that the duration of winters in these latitudes has been subjected to great variation.

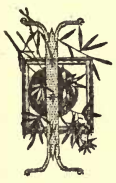
Herr Gätke further objects to the theory that migration from the north is altogether due to a lack of food. He remarks: "This explanation would have much to commend it if all the individuals of a species left their breeding places in the highest northern latitudes simultaneously, and if all followed a north to south line of migration. I have, however, shown myself, firstly that the young and old birds of a species migrate at widely different times; and secondly, that a number of species perform their migrations on an east-to-west line of flight." The

explanations accounting for the first mentioned fact have already been discussed, and whether we accept the theory of an east-to-west line of flight or not, matters very little, as it is undoubtedly the case that the winters in Western Europe are milder than those in the east. Moreover there is absolutely no evidence to prove that the old birds set out so very long after their progeny; indeed, observations all tend to prove that the latter migrate slowly at first and in short stages, and that in many cases it is only the actual advent of wintry conditions that brings about those rapid torrents of migration alluded to by Herr Gätke on p. 146. Whether birds fly by daylight or in darkness has no bearing whatever on this point, and while there may be no temptation to break the flight at an inhospitable little island, the reverse is probably the case on encountering more favourable localities.

Herr Gätke concludes his chapter on "What Guides Birds during their Migration," with a reference to the rare occurrence of a migration which may be described as not only retarded, but actually turned back, through meeting with wintry conditions in the land towards which it was travelling. In his view this occurrence was similar to that experienced by Seebohm in the valley of the Yenesay, when the latter was awaiting the break up of winter on the arctic circle. Another interpretation of the phenomena, however, as regards this particular instance may be put forward. Mention has frequently been made of those supplementary migrations which so frequently take place at Heligoland late in the winter. Birds suddenly appear travelling past the island in large numbers, their presence at these times being said to unfailingly indicate the proximity of severe weather. We are unfortunately told but little of this interesting incident beyond the fact that on becoming aware of the strong migration in progress, the author came to the conclusion that the spring movement had set in with remarkable force and at an earlier period than usual. On becoming aware, however, of the direction in which the birds were travelling, after considerable reflection, he came to the conclusion that the flocks comprising the flight had already once passed the island, and were now compelled by the severe weather encountered ahead to retrace their steps. May it not

have been the case, however, that owing to the previous mild weather these birds had wintered in some quarter close at hand, with no intention of migrating any further, unless compelled by severe weather? The circumstance is alluded to here on account of the suggestion on the part of Herr Gätke that these flocks had apparently *hit upon* the right way of escaping from a difficulty.

EXCEPTIONAL MIGRATION PHENOMENA.



N the present chapter Herr Gätke endeavours to prove that the occurrence in Heligoland or other localities of individuals, of species, whose normal ranges do not extend so far by hundreds, and in some cases thousands of miles, is due not to accident, but to a voluntary and conscious intention on the part of these wanderers, and that this voluntary act is in its turn the result of recurring causes, or in other words, is governed by certain laws which have been previously overlooked. It will be interesting, therefore, to follow him in his explanation of these laws.

In rejecting the formerly accepted opinion that the occurrence of these casual visitors has no scientific value whatever, the remarks: "This was the outcome of the traditional error, according to which these strangers were, as a rule, simple and inexperienced young autumn birds which had either been driven out of their normal course by storms, or were wandering about the world at haphazard" (p. 114). The latter statement seems to be stretching a point. Few naturalists ever imagined that any bird, young or old, wanders about the world at haphazard. In disproof of the statement that this straying from the customary track is most frequent on the part of young birds, Herr Gätke first brings forward the evidence of those species whose breeding ranges lie some hundred of miles to the south east of Heligoland. In alluding to the latter he calls attention to the fact that twelve old against two young summer birds of the Black-headed Bunting (Emberiza melanocephala) have been obtained, and in the case of the Eastern Pied Chat (Sax. morio), the Black-eared Chat (S. aurita), and the Desert Chat (S. deserti), two old examples of

each species as against one young bird of the last-named only. Again, almost all the examples of the Rose-coloured Starling which have occurred are old birds, and so on.

Considering the relative situations of the breeding grounds and winter quarters of these species, this is just what might have been expected. The general direction of their migratory flight in spring being south-east to north-west, and, of course, the reverse in autumn, how could it be expected under these circumstances, that young birds should migrate in an exactly opposite direction to their parents? The improbability of the latter fact seems to have occurred to Herr Gätke, for, writing on the Short-toed lark (p. 357), he remarks: "In the absence of any single actual instance in support of it, the idea of an autumn migration directed to the north-west from Greece or Asia Minor cannot be entertained." He further adds in alluding to these exceptional visitors: "No more do the conditions under which such migrants make their appearance admit of the conclusion that these movements are merely of a roving or blundering kind, without definite plan or aim." It is difficult, however, to see to what else but blundering we are to attribute the presence of the few young birds of these south-eastern species, which have been captured so far from the home in which they were reared. It is simply impossible to prove an intention on their part to undertake a journey in an exactly opposite direction to that of the vast majority of their fellow-travellers. Why should it be assumed from the fact of eastern and north-eastern species occurring in autumn and those from the south and south-east in spring, that these casual visits are dependent on definite laws or causes of a recurring kind. The very lines of flight are sufficient explanations in themselves. It would, of course, be absurd to expect the appearance of young from the latter quarter in spring, or in other words, before they are hatched.

In the idea of Prof. Newton, if we grant the existence of laws determining the flight of every winged vagabond they must be very different from those which are obeyed by birds commonly called migratory. The former laws would seem to be controlled by purely external circumstances, and while we may predict with a reasonable degree of certainty the occurrence of a certain

number of stragglers from North America or Asia within a given number of years we cannot say to a year when any particular example will arrive. In a given period it might be safely predicted that there will be a certain number of accidents in the streets of London or any large town, some of which may be said to be governed by causes of a recurring kind, such as the prevalence of fogs and gales. Nevertheless, we still look upon these casualties as accidents, not as the result of definite laws. It should not be forgotten that the list of waifs and strays on Heligoland is the result of more than fifty years of observation in a locality "where literally not a bird escapes notice." Under the circumstances, though the list is certainly a remarkable one, Herr Gätke seems to attach far too great an importance to the evidence it presents.

He attributes the presence of these south-eastern species on Heligoland to a most curious cause, *i.e.*, the death of one of a pair during the period of incubation. After an accident of this kind the surviving parties, to satisfy the persistent impulse towards accomplishing the act of propagation, commences the migratory journey anew!!! Such a theory is quite opposed to all experience. Probably in no locality are the sexes of birds so evenly balanced that each individual finds a mate. In some species the males undoubtedly predominate. Under these circumstances it would be remarkable, if it were necessary, for the female to undertake a fresh journey in quest of a new partner. On the contrary, it is well known that on the death of either male or female the survivor finds a new mate without any difficulty, and over and over again it has been remarked with what wonderful celerity this takes place. To take the case of the Black-headed Bunting. Herr Gätke mentions that with the exception of the young bird of the year which was shot in August, all the examples procured occurred between May 6th and June 18th, *i.e.*, from the commencement and during the height of the breeding season; and, moreover, of these, five were old males, three old females, and lastly, a male in its second year. A further old pair were added to his collection by Mr. J. H. Gurney; these facts thus show that females occur nearly as frequently as males.

It may be pointed out here that several common species, such

as the Fieldfare, Blackbird, and Redbreast, have been met with in the lonely island of Jan Mayen. It seems absurd to suggest that these individuals migrated thither on account of losing their partners in some more southern clime.

It is very difficult to follow Herr Gätke in this theory. He appears to consider that in the spring the impulse to migrate, and the desire for propagation are identical. No doubt the state of the breeding organs at this period has considerable influence in causing the departure of birds from their winter quarters. But when once the breeding grounds are reached and pairing has taken place, it is difficult to see how their condition can re-kindle in either survivor of a pair an impulse to travel many hundreds of miles beyond their proper quarters in search of a fresh mate when there must be opportunities to satisfy this desire near at hand.

If we turn to the author's facts relating to the south of England and examine them in the light of this theory, we shall find still more remarkable evidence. Referring to the Bee-eater, we find it stated (p. 121), that twenty examples were seen in one day in Norfolk, and twelve were shot within the same period of time at Helston, in Cornwall. We must, therefore, assume that twenty individuals in the first case and twelve in the latter, living in the same localities, had respectively lost their mates at an identical period, and had started together on their migratory flight afresh in search of new partners. We must also assume that the victims were either all males or all females, otherwise we should have expected the survivors to have paired among themselves. We, however, know that both sexes are represented amongst the individuals of this species which reach our southern counties. Moreover, the Bee-eater breeds freely in south-eastern Europe and winters in north-western India. Therefore, under the same circumstances, the species should visit Heligoland pretty frequently like the Black-headed Bunting. The reverse, however, is the case.

It will not be uninteresting to examine the geographical ranges of the species said to reach Heligoland from regions lying to the south-east of the island.

Eleonora Falcon.—The Heligoland example of this Falcon was seen by Aeuckens, but *not obtained.* The species was after-

wards identified from a skin. It is found in Spain, Sardinia, Greece and Syria. It also occurs in Northern Africa (Bree.).

Lesser Kestrel.—"The homes of this small Falcon extend through the whole of Southern Europe" (Gätke, p. 176). "In the Spanish Peninsula it is very numerous" (Saunders). This species has occurred several times in the British Islands.

Rose-coloured Starling.—This may fairly be called a south-eastern species. Though in the year 1875 it bred in large numbers in Italy. From the fact of the flocks following flights of locusts this is a most erratic bird. It has occurred very frequently in the United Kingdom, and in many parts of Europe.

Apparently Herr Gätke finds a difficulty in accounting for the presence of this species on Heligoland in August and his explanation is rather far fetched. The majority of the individuals captured there have been taken in June. These he would account for on the theory that they are the survivors of pairs who have lost their mates. It will be noted, however, it was not until the 17th of the latter month that the first eggs were laid, when the species bred so numerously in Italy (Saunders). With regard to the examples obtained later in the summer, no less than eight having been killed in August, 1853, and again three young in grey early plumage in September, 1860, it is suggested that the species may breed in European and Asiatic Russia as far north as the latitude of Heligoland, and that the young forsake their normal course of flight and turn to the west on their autumn migration. Or again, the possibility is suggested that they are individuals which have been bred in Scotland and when captured on Heligoland are on their way home to their usual winter quarters. Any theory seems, to the author, more preferable than the simple fact that they are individuals entirely out of their reckoning. It is not unreasonable to assume that an erratic species like the present may be less acute in its powers of orientation than species which regularly frequent the same breeding grounds.

Ehrenberg's Redstart.—A single example of this species obtained June 12th, 1864—an old male. It is found in Asia Minor.

Rufous Warbler.—Herr Gätke does not devote a chapter to

this species. We may infer that only a single individual has been taken. It has occurred several times in the south of England. Twice in September and once in October. In Southern Portugal and Spain it is abundant (Saunders).

Orphean Warbler. — Two recorded as captured many years ago on the authority of Reymers. One met with by Herr Gätke, July 8th, 1876. This species has occurred in Great Britain. It breeds sparingly in France. In Portugal and Spain it is abundant wherever the olive grows. It visits Savoy in summer, is local on the mainland of Italy, and very rare in the islands; passes annually up the valley of the Rhone to the Vosges. The vicinity of Metz and Luxembourg; and straggles to Belgium and to Heligoland, east of which it is unknown. . . . it occurs regularly in Dalmatia, Greece, Northern Russia, &c., &c. (Saunders).

Olivaceous Warbler.—Frequents South Eastern Europe in summer, wintering in Northern Africa. A single example obtained September 20th, 1883. Herr Gätke remarks, p. 303, "we may probably assume that the individual in question had been roving about ever since June in northern and north western areas"!

Olive-tree Warbler.—Breeds in South-Eastern Europe *also Eastern Spain.* Winters in Northern Africa. A single example killed on the island in 1860.

Paddy-field Warbler. — An uncommon species in Eastern Europe. A single example captured June 12th, 1864.

Black-eared Chat.—Breeds throughout Southern Europe, &c., &c. Two examples obtained, one May 12th, 1860, the other October 26th, 1851.

Russet Chat.—Breeding range extends from Portugal and North West Africa to Greece. A chat, said to be identical with this species, killed about 1840.

Desert Chat.—Breeding range extends from Algeria, through Egypt, Arabia, Palestine, &c. Herr Gätke remarks:—"This native of the hot and barren desert has on three occasions emigrated from its southern home to Heligoland in the far north." An old male shot, October 4th, 1856; a female caught, October 26th, 1857; a fine old male shot, June 23rd, 1880.

Commenting on the fact that on November 26th, following, an old bird was shot near Stirling, Herr Gätke writes: "There can hardly be any doubt that both the latter examples left their home at the same time and from similar motives, and that while following the direction of their spring migration, the one got no further than Heligoland, while the other by a less perilous route, got so much further to the north west."

The butterfly, Papilio podalirius, was observed on the same day as the first named example, viz., June 23rd, 1880. "It too—we are told—had probably been led beyond the limits of its home and across the sea by the fine warm weather, and light south-easterly and easterly winds." From this passage it appears, it was these winds which induced the two Desert Chats to perform their abnormal migration, not the loss of their mates.

Eastern Pied Chat.—A south-eastern species. One killed May 9th, 1867; a second, June 6th, 1882.

Calandra Lark.—Breeds throughout all the countries bordering the Mediterranean. An example said to have been shot by Reymers, June, 1839 or 1840.

Black Lark.—A winter visitant to Southern Russia, breeding in Central Asia. A female, shot April 27th, 1874; a fine old male subsequently shot, July 27th, 1892.

Pallas' Short-toed Lark.—A resident in Southern Russia. One shot May 26, 1879.

Short-toed Lark.—Breeds throughout the countries bordering the Mediterranean. About thirty examples killed, partly in spring and partly in autumn. The former examples on account of their more ferruginous colour, compared with those which have been shot in October and November, are said to undoubtedly have been derived from Greece and Asia Minor. Herr Gätke remarks: "The home of the latter in Asia must extend to the latitude of Heligoland, and the birds there undoubtedly joining themselves to the many other species from the far east, whose autumn migration proceeds in a westerly direction. In the absence of one single actual instance in support of it, the idea of an autumn migration directed to the north west from Greece or Asia Minor cannot be entertained"!!! Why not here more reasonably suggest that these autumn

examples had been roving about as in the case of the Olivaceous Warbler and were captured on their return migration.

Black-headed Bunting.—This species has already been commented upon.

Cirl Bunting.—It is remarkable to find this species included in the list of casual visitors from the south-east as we read (p. 371). "The bird, however, is a pre-eminently western species . . . . and in fact affords another proof of the rare occurrences of western and southern species in Heligoland." An example killed April 22nd, 1862, and a second March 31st, 1883.

Red-headed Bunting.—An eastern species. Two old males obtained. First on June 20, 1860. Second some years later in the month of September.

Meadow Bunting.—Resident in Southern Europe and Northern Africa. An authentic example killed March 8th, 1882, an old male. An individual shot at this early date can hardly have lost its partner.

Cretschmar's Bunting.—A summer visitor to South Eastern Europe occasionally occurring as far west as France. "About a dozen examples, for the most part fine males, obtained between May, 1848 and 1867. In the course of the last twenty years, however, it has been observed and shot on one occasion only." In accounting for the latter fact, two explanations occur in the light of Herr Gätke's theories. First, this species has latterly enjoyed a remarkable immunity from casualties during the breeding season; or secondly, as he suggests himself, the absence now of warm and fine weather in the early summer.

Large-billed Reed Bunting.—A resident in South Eastern Russia. One caught April 24th, 1879, others possibly seen. It is difficult to think that this individual had already lost its mate so early in the year. The species, moreover, is said to be a resident in its European breeding grounds.

As has been pointed out, the presence of these so-called south-eastern species on Heligoland is in one place attributed to the death of one of a pair of breeding birds, causing the survivor to take up the migratory flight anew, in search of a fresh mate. It is, therefore, interesting to read on p. 10 that, "occurrences of this kind, *i.e.*, south-eastern species, are conditioned by the co-operation of

so many meteorological factors, that completely successful results in this direction are extremely rare."

Marsh Sandpiper.—Breeds from Hungary eastwards. A single example obtained May 7th, 1862; an early date for this species to have lost its partner.

Black-winged Stilt.—Breeds throughout Southern Europe; said to have been formerly well known to Heligolanders, an example seen June 25th, 1879, by Jan Aeuckens.

From the above list it will be seen that the majority of these so-called south-eastern species have occurred on Heligoland only once in fifty years. Further, that so far from being confined to the south east, many, on the contrary, breed both in Northern Africa and throughout the countries bordering the Mediterranean in Europe. Some are again resident species and others have occurred at such early dates as to throw great doubt on the supposition that they have taken up the migratory flight anew owing to the loss of their nesting partners. Under the circumstances it seems idle to attempt to prove that these irregular occurrences are due to the influence of definite laws. It is far more reasonable to suppose the majority have simply over-shot the mark in their eagerness to reach their breeding grounds. No doubt the sense of direction, or whatever we like to call the means by which migrants find their way, varies greatly in individuals and in odd cases is altogether deficient. Or, again, single individuals may frequently attach themselves to migratory flocks of other species wintering in the same locality but travelling to different breeding grounds, and so get carried out of their proper track. The most recent capture of the Pine Grosbeak in England occurred in the Midlands during an unusually strong migration of Fieldfares, a flock of which it had, no doubt, joined, though properly speaking it is not a true migrant. Strong winds also, at times, exert a certain influence on the appearance of these erratic wanderers.

In the light of the foregoing evidence, it will hardly be worth while to discuss the cases of species from Northern Africa or Western Europe, which have occurred on Heligoland. According to Herr Gätke, birds in the latter locality have a great disinclination to migrate to the east. It is difficult to say to what species

he refers, however, as there are remarkably few peculiar to this part of the continent.

Without going into a list of American species occurring in Great Britain and Heligoland, a few remarks may be made on the probable manner and route by which they reach their respective localities.

From the fact of migrants in narrow seas settling so frequently on the rigging of ships there can be no doubt that many a bird is saved from drowning by this temporary aid, and it is only reasonable to suppose that the presence of certain of the smaller American species in Europe has been greatly aided in this manner. Herr Gätke's objection has little weight that the time taken up in resting only adds to the period during which these individuals must go without food. This fact is evident, but still, as he tells us himself, birds migrate on empty stomachs, and on reaching Heligoland, so little are they affected by their efforts, that a stay of only a few hours is sufficient to fully recuperate their powers. A rest, therefore, seems of more value during these long flights than food.

It is a curious fact and one that should be by no means lost sight of, that the American birds captured in Europe or observed out at sea, have been in nearly all cases single individuals; very rarely flocks. In the face of this it can hardly be doubted that the majority of the smaller species have been brought over in cages and have escaped on nearing or on arrival at land.

Of the larger species, which have occurred in Europe, such as the American Bittern and the various waders, the greater number breed in the far north and no doubt are often carried beyond their proper nesting stations by various influences. The further north they go, the more chance any slight deviation to the east will be likely to convey them to Europe on their return journey. It must not be forgotten too, that as far as we know, there is nothing to prevent these northern breeding species from flying completely across the poles to the breeding grounds of other species which regularly pass our shores on migration. When we reflect how many birds have been observed to stray to great distances beyond their proper quarters—the capture of the Hoopoe in Spitz-Bergen may be cited as an instance of the latter fact—the probability of this assumption becomes apparent.

By what precise route these American species reach our shores it is impossible to say, but from the fact that the majority have been obtained on our eastern and southern coasts it is most probable that they have travelled down the shores of Norway and then crossed the North Sea, in company with our customary visitors; or they may, as Professor Newton points out, have actually crossed the Atlantic with the aid of a strong westerly gale. However, Herr Gätke will not admit the assistance of the latter agency as at all necessary. The voyage across the Atlantic according to his theory is undertaken as a voluntary act, for he writes that the objection on the part of birds to migrate east in the autumn; which according to his view is apparent in Western Europe, ceases as soon as we cross the Atlantic. Yet after discussing the question of the route by which American species reach Heligoland, which he thinks there can be no doubt is accomplished by first crossing the Atlantic and afterwards the British Isles or France, he is ready to assert in support of his favourite theory of an east to west flight, that the example of Turdus Swainsoni, captured October 2nd, 1869, "no doubt reached this island by an east to west route of migration" (p. 116). The latter individual is thus required to traverse the Pacific and the whole of the continents of Asia and Europe.

With reference to another species, *i.e.*, Tringa maculata—to which Herr Gätke draws attention, pointing to the fact that nineteen instances of its occurrence in England have been recorded, it may be remarked that in the opinion of Mr. J. H. Gurney, who has been at considerable pains in investigating each case, very few are open to credence, mistaken identity being probable in most instances.

In objecting to the theory that birds may be blown across the Atlantic by westerly gales, Herr Gätke alludes to the fact that the Virginian Golden Plover is of the rarest occurrence in Europe, contrary to what might be expected from the fact of its migrating across the ocean in large numbers *via* the Bermudas to Brazil. It is quite possible, however, that this Plover, from its close resemblance to the Golden Plover, may be overlooked. Only an ornithologist would detect the difference, and, moreover, he

forgets that he has himself called especial attention to the
that this species is one of the most powerful fliers known
bird which can maintain a speed of over 200 miles an hour
long period, would hardly be likely to be blown very far out
course by the most violent of gales. Two other species, I
Sabinii and Rossi are included in his American list of Heli
captures, though so little is known of their breeding grou
Recently, however, Nansen has met with the latter in
numbers in Franz Joseph Land, thus rendering it improbable
the Heligoland example may have come from America at all.

In the light of the evidence discussed in the present and fo
going chapters, it seems very hazardous to assert the opin
that the migrations or wanderings of any species are stric
confined to a rigidly mapped out route. Probably every b
goes its own way. Those huge assemblages which pass pa
cular points result from the fact that the path of many in rea
ing certain localities is for a long distance identical. Ev
species, nay every little clan of birds has its own migrat
history, resembling as a whole the story of the common fli
but on the other hand differing at many points in its mi
details. So far from being characterised by a flight in two m
directions, the route followed will be partially governed by t
relative positions of breeding grounds and winter quarters, a
the time honoured paths by which the travelling hosts have f
unknown ages passed from one to the other. Even in the li
of Herr Gätke's theories the simple east to west autumnal fli
has at some point to be supplemented by a turn to the south
south-west, and again the course of the north and south jour
in the countries lying towards the head of the Mediterra
Sea, gives way to a flight from north-west to south-east.